

PINNACLE

TECHNOLOGY INC



NEUROPHYSIOLOGICAL PRODUCTS

FOR PRECLINICAL *IN VIVO* RESEARCH

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Thank you for choosing Pinnacle Technology for your research needs. We offer a range of turn-key systems for neurophysiological studies using freely moving animals and are committed to developing new tools that simplify measurement, reduce cost, and enable new research. In addition, Pinnacle offers a host of supporting products ranging from cages to software analysis suites. We pride ourselves in providing exceptional customer service and are available to assist you with every stage of your research process.

By forging collaborative relationships with our clients, we are able to develop cutting-edge tools that improve and simplify your research. We look forward to working with you.

All the Best,

Donna A. Johnson
President and CEO

INFORMATION AND POLICIES

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Ordering Information:

General: Products may be ordered directly from Pinnacle Technology, Inc., or from one of our approved distributors (see: <http://www.pinnaclet.com/distributors.html>). Some products may not be available in all countries.

Biosensors and Carbon Fiber Sensors: Pinnacle Technology, Inc., requires seven business days notice prior to requested date of shipment for biosensor or carbon fiber sensor orders.

Payment Terms: Net 30 days from date of invoice for customers with established credit. Prepayment or COD may be required if credit has not been established. Major credit cards are accepted. Unpaid balances are subject to a late-payment fee of 1.5% per month. Pro-forma invoices are available for international orders.

Use of Products: All Pinnacle Technology, Inc., products are sold for laboratory research use only. Pinnacle Technology, Inc., products have not been approved by any government agency for use in human subjects or human testing.

Shipping Information:

United States: All orders ship F.O.B. Lawrence, KS. Standard orders are shipped FedEx® Ground (biosensor orders are shipped FedEx® 2nd Day). Freight charges are added to the final invoice.

International: Purchaser is responsible for payment of all import duties, tariffs, taxes, insurance, and other related charges. Pinnacle Technology, Inc., ships via the purchaser's courier of choice (UPS®, FedEx®, DHL®) using the purchaser's courier account number. Orders WILL NOT BE SHIPPED without this information. Pinnacle Technology, Inc., accommodates orders shipped through domestic shipping brokers.

Product/Price Notices: Prices and specifications are subject to change without notice.

Product Return Policy: All product returns require a Return Merchandise Authorization (RMA) number. Contact a Pinnacle Technology, Inc., representative to obtain an RMA number and proper RMA documentation. Returns should be shipped to Pinnacle Technology, Inc., within 30 days of RMA number issuance. RMA documentation must be included in the return shipment, and the customer is responsible for all shipping and handling charges. Standard items that have not been used or damaged may be returned within 10 days of original delivery for a credit or refund. A 15% restocking charge will be deducted from the refund or credit at Pinnacle Technology, Inc.'s discretion. Pinnacle Technology, Inc., does not offer refunds or credits on special, custom, or made-to-order products with custom modifications. All products returned for repair or replacement must be sanitary, cleaned appropriately, and securely packaged.

Warranty Information: In general, products are warranted against defects in material and workmanship. Purchasers must comply with Pinnacle Technology, Inc.'s policy regarding returns. Refer to Pinnacle Technology, Inc.'s website (www.pinnaclet.com) for detailed warranty information.

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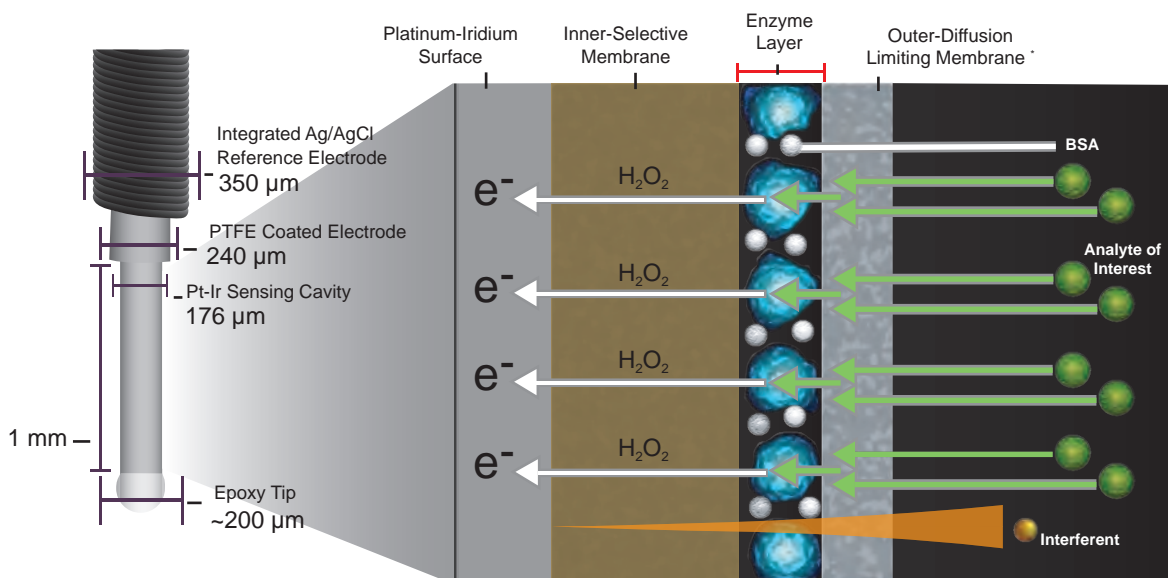
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PINNACLE CNS BIOSENSORS

CNS BIOSENSORS monitor real-time changes in neurochemical concentrations. With Pinnacle's turn-key electronic and software systems, users can record and analyze second-by-second concentration changes of neurochemicals in freely moving animals.

Pinnacle currently offers glutamate, glucose, lactate, choline, and ethanol biosensors. Our biosensors function by the enzyme-mediated processing of the analyte of interest. This results in the production of hydrogen peroxide that is then detected by oxidation at a Pt-Ir electrode. Electroactive interferents present in the brain are excluded via a passive selective membrane and through active removal when necessary.

Our sensors are shipped within seven business days of order receipt and include a warranty. Custom sensor sizes are also available. Contact Pinnacle for details.



* Outer-diffusion limiting membrane may not be present on all Pinnacle biosensors

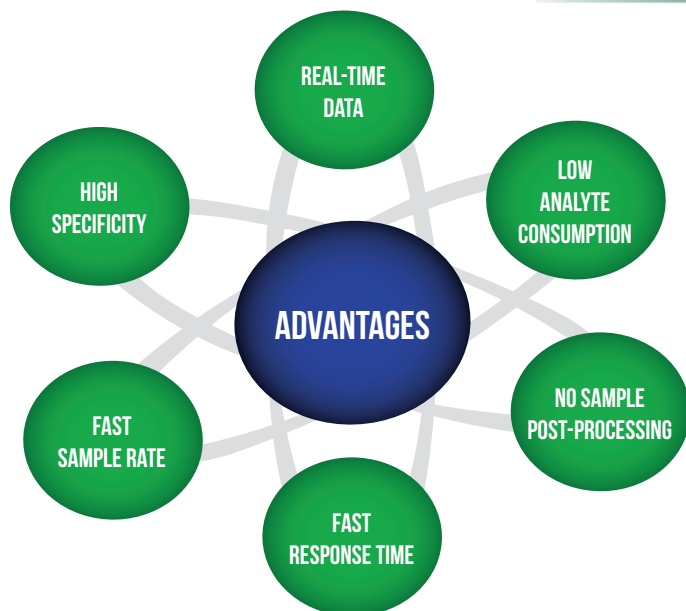
COMMON USES

- In vivo* monitoring of brain chemical microenvironments
- Neurochemical monitoring during behavioral and physiological activities
- Drug screening, including neuropharmacological effects
- Identification of biomarkers
- Investigating cognition, behavior, circadian cycles, stress, learning, memory, sleep, seizure, vigilance state, and new drug effects

CNS BIOSENSOR CHARACTERISTICS

	<i>In Vivo</i> Lifetime	Limit of Detection
Glutamate	36 hours	0.05 - 0.1 µM
Glucose	96+ hours	2 - 5 µM
Lactate	96+ hours	5 - 10 µM
Ethanol	6 - 8 hours	0.1 - 0.5 µM
Choline	8+ hours	0.05 - 0.1 µM

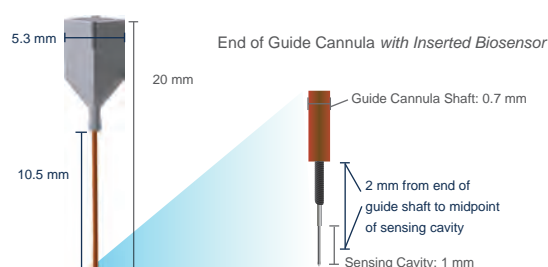
CARBON FIBER SENSORS (CFS) are used in conjunction with Pinnacle's tethered and wireless potentiostats to measure the presence of total biogenic amines in the brain using fixed potential amperometry (FPA). They are also used with fast scan cyclic voltammetry (FSCV) systems. All Pinnacle CFSs require an Ag/AgCl reference electrode (7065). The sensors are 34 µm in diameter and 0.5 mm in length.



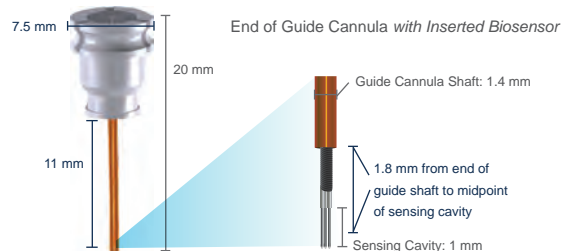
CNS BIOSENSORS AND GUIDE CANNULAS

CNS BIOSENSORS are purchased by cannula type and analyte of interest; carbon fiber sensors are purchased by cannula type. Pinnacle recommends the use of a guide cannula system for optimal results when implanting and recording from sensors in the brain of a freely moving animal. We manufacture standard biosensor electrodes (Pt-Ir wire with an integrated Ag/AgCl reference) that are compatible with multiple guide cannula types: Pinnacle's single-barrel and tri-barrel cannulas for rats, BASi cannulas for rats, and smaller BASi cannulas for mice. Sensors with no cannula and custom sensors are also available for purchase. All sensors sold by Pinnacle are for non-human use only.

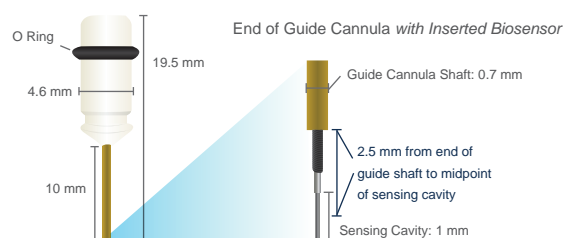
SINGLE-BARREL FOR RATS



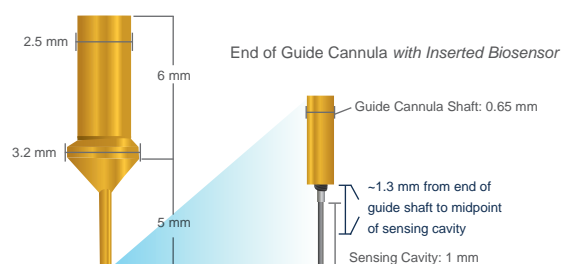
TRI-BARREL FOR RATS



BASi FOR RATS



BASi FOR MICE



CNS SENSOR TYPES

Product	Item #
No cannula headpiece	7001
7001-Choline 7001-Glutamate 7001-CFS*	
7001-Ethanol 7001-Lactate 7001-CFS-F**	
7001-Glucose	
BASi cannula headpiece for mice	7004
BASi cannula headpiece for rats (wireless)	7002
Pinnacle cannula headpiece for rats (wireless)	7005
BASi cannula headpiece for rats (tethered)	7011

* 7001-CFS: Carbon Fiber Sensor ** 7001-CFS-F: CFS (fixed in cannula)

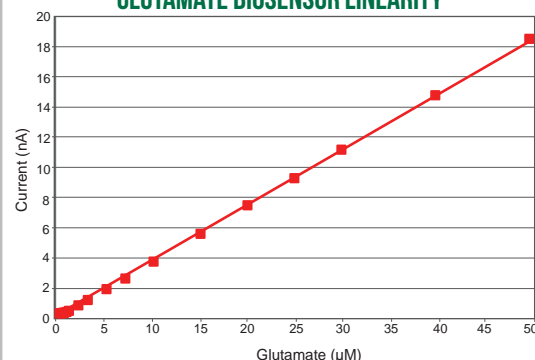
All sensor types can be ordered in any of the analytes/configurations listed under 7001. For example, a glutamate biosensor with a BASi cannula headpiece for mice is ordered as 7004-Glutamate.

GUIDE CANNULA TYPES

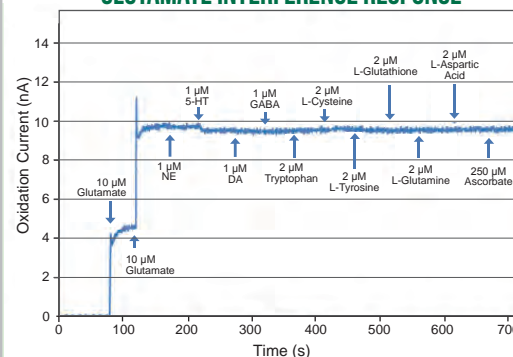
Product	Item #
BASi guide cannula for mice	7032
BASi guide cannula for rats	7030
Pinnacle single-barrel cannula for rats	7040-S
Pinnacle tri-barrel cannula for rats	7041-S

LINEAR SELECTIVE FAST

GLUTAMATE BIOSENSOR LINEARITY



GLUTAMATE INTERFERENCE RESPONSE



Pinnacle biosensors are selective for the analyte of interest and are linear at normal *in vivo* oxygenation levels over a physiologically relevant range, as shown in the diagrams above.

WIRELESS SYSTEMS FOR RATS

TWO-CHANNEL and **THREE-CHANNEL WIRELESS BIOSENSOR SYSTEMS** are available for recording neurochemical concentrations in freely moving rats. Both turn-key systems use Bluetooth® technology to wirelessly transmit data to Pinnacle's Sirenia® Acquisition software via a USB dongle. They provide a platform for high capacity biosensor studies and are well suited for behavioral experiments.



- 1 Stereotactically placed guide cannula(s) allow for the insertion of biosensors post-surgery.
- 2 The Rat Hat bottom is affixed to the skull with bone screws and dental acrylic. It houses the wireless electronics, battery, guide cannulas, and biosensors.
- 3 A low-powered, wireless, two- or three-channel potentiostat applies a bias and transmits up to three digitized signals to a paired Bluetooth® USB dongle that interfaces with Pinnacle's Sirenia® Acquisition software for data recording.
- 4 The Rat Hat top protects the system.



KEY FEATURES

UP TO THREE CHANNELS
TRANSMISSION RADIUS: 6 METERS

UNTETHERED FREELY MOVING ANIMALS
SUPPORTS SIMULTANEOUS BIOSENSOR RECORDINGS

HARDWARE KITS

8100-K9: Three-Channel Wireless Biosensor System

8173 - Bluetooth® potentiostat

9052 - USB extension cable

9054 - Bluetooth® dongle

8100-K5: Two-Channel Wireless Biosensor System*

ACCESSORY KITS

8100-K10: Three-Channel Wireless Biosensor Accessories

7036 - Probe clamp assembly	8111-16 - 1/8" screws (pkg. of 16)
7040-S - Single-barrel cannula with stylet (6)	8112 - Drill bit (2)
7041-S - Tri-barrel cannula with stylets (2)	8134-20 - 20 M test load (2)
7043 - Stereotax holder for tri-barrel cannula	8147-A - Hex screwdriver
7044 - Stereotax adapter	8156 - Battery remover
7045 - Hex screws for probe clamp	8241-S - Screwdriver for 1/8" screws
8107-3C - Rat Hat top	9005 - Powered USB hub
8108-3C - Rat Hat bottom (4)	9065-8164-M - Battery (8)

8100-K7: Two-Channel Wireless Biosensor Accessories*

* Kit contents for the two-channel biosensor system are available on our website. Biosensors sold separately.

ALSO AVAILABLE AS A BACKPACK

DISPOSABLE
ITEMS

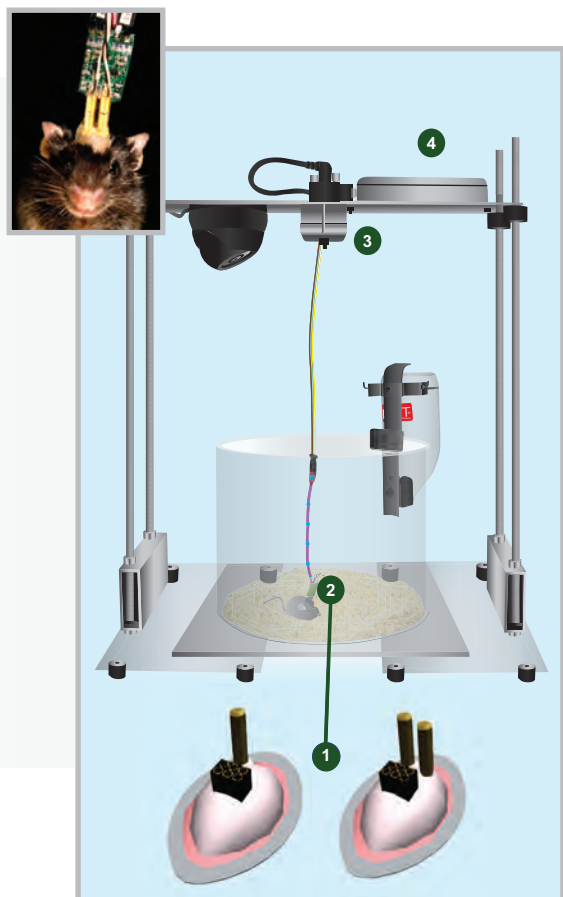
FOR RATS

Item #	Product
7030	BASi rat guide cannula
7040-S	Single-barrel cannula
7041-S	Tri-barrel cannula
8108-BLE	Rat Hat bottom for two-channel
8108-3C	Rat Hat bottom for three-channel

Item #	Product
8111-16	1/8" screws (pkg. of 16)
8112	Drill bit
9031	Battery for two-channel (pkg. of 5)
9065-8164-M	Battery for three-channel

TETHERED SYSTEM FOR MICE

The **MOUSE BIOSENSOR SYSTEM** features configurable input channels to record neurochemical concentrations. This tethered system employs a head-mounted preamplifier for measuring up to two biosensors simultaneously in one animal, providing a turn-key solution for biosensor recordings in mice.



- 1 Stereotactically placed guide cannulas allow for the insertion of biosensors post-surgery. Prefabricated headmounts are affixed to the skull with dental acrylic and act as a connection port for the two-channel biosensor preamplifier.
- 2 Head-mounted preamplifiers house two connectors for biosensors. The rigid connection ensures high-quality, artifact-free data.
- 3 A low-torque commutator allows for unencumbered freedom of movement.
- 4 The data conditioning and acquisition system performs secondary amplification and filtering before sending data to Pinnacle's Sirenia® Acquisition software for collection.

KEY FEATURES

LOW TORQUE
HEAD-MOUNTED AMPLIFICATION

WEIGHT: 2.2 GRAMS
SUPPORTS UP TO 2 SIMULTANEOUS BIOSENSOR RECORDINGS

HARDWARE KIT

8400-K1-2BIO: Tethered Mouse Biosensor System

8401-HS - Data conditioning and acquisition system

8408 - Mouse commutator/swivel

8426 - 18" mounting plate

Cables for one animal, software, and manuals are also included.

TETHERED SYSTEMS FOR RATS AVAILABLE

PREAMPLIFIER KITS

8400-K3-2BIO: Preamplifier Kit for Two Biosensors

8406-2BIO - Mouse preamplifier for up to 2 biosensors	8209 - 0.10" screws (3 pkgs. of 8)
7032 - BASi mouse cannula (12)	8241-F - Screwdriver for mouse screws
7033 - Bio-only headmount (6)	8254 - 23-gauge needle (6)
7035-M-BAS - Probe holder for mouse cannula (2)	9005 - Powered USB hub
8134 - Test load (2)	

8400-K3-BIO: Preamplifier Kit for One Biosensor

Components of this kit are the same as above except for the quantities of 7032 (6) and 7035-M-BAS (1). Biosensors sold separately.

FOR MICE

Item #	Product
7032	BASi mouse guide cannula
7033	Bio-only headmount
8209	0.10" screws (pkg. of 8)
8254	23-gauge needle

ADD SYNCHRONIZED VIDEO

See page 22 for details.

DESKTOP POTENTIOSTAT

Pinnacle's recently redesigned **FOUR-CHANNEL DESKTOP POTENTIOSTAT** provides a cost-effective, easy-to-use, and highly accurate system for the development and use of high impedance, amperometric biosensors and biosensor arrays. It is well suited for anesthetized animal experiments, brain slices, and other *in vitro* studies. Each of the system's four channels has one TTL input, one TTL output, and one analog output. The potentiostat is compatible with Pinnacle's biosensors and third-party sensors.

NEW
DESIGN



KEY FEATURES

- 4 channels
- Maximum sampling rate: 4 Hz
- 4 TTL inputs
- 2 terminal, fixed potential
- Current range: 0 - 20 μ A
- 4 TTL outputs
- Resolution: 3 fA
- Bias range: -2.048 to +2.048 V
- 4 analog outputs

HARDWARE KIT

8100-K4: Desktop Potentiostat System

8102 - Desktop potentiostat

8109 - Sensor adapter cables (4)

8118 - Power supply

8124 - Shorting cap

8125 - BNC to alligator leads cable (4)

8155 - BNC test load (4)

9005 - Powered USB hub

Cables, software, and manuals are also included.

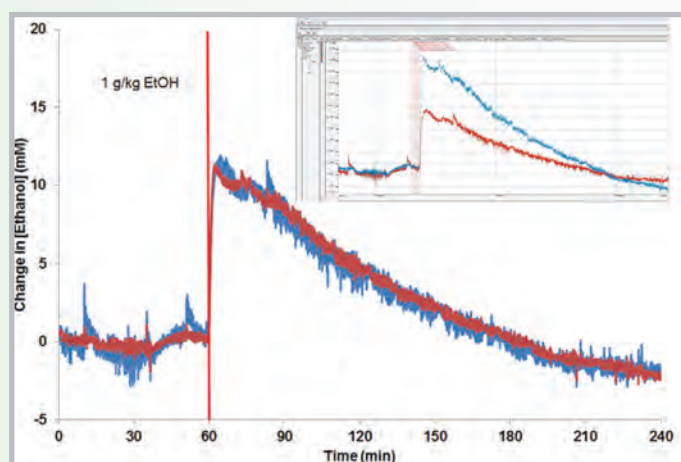
COMPATIBLE WITH THIRD-PARTY SENSORS

CALIBRATION KITS

To relate the *in vivo* current changes measured by a CNS biosensor to actual changes in analyte concentration, it is necessary to calibrate the biosensor at the conclusion of the *in vivo* experiment. Pinnacle offers a number of *in vitro* calibration systems that allow the simultaneous calibration of four to eight biosensors.

CALIBRATION KITS

Product	Kit #
Tethered mouse <i>in vitro</i> calibration kit	7000-K1-T
Wireless rat <i>in vitro</i> calibration kit (use with BASi cannulas)	7000-K2-W-BAS
Wireless rat <i>in vitro</i> calibration kit (use with Pinnacle cannulas)	7000-K2-W-P

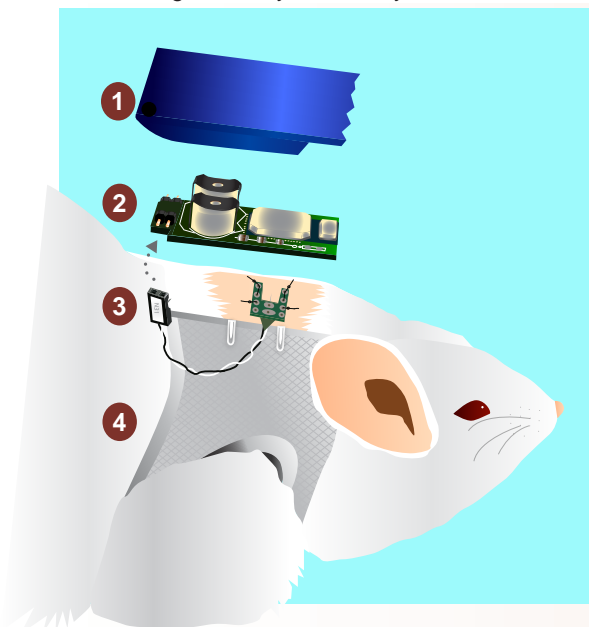


CORRELATING CURRENT TO CONCENTRATION

Shown in the image on the left are *in vivo* recordings from two alcohol biosensors implanted contralaterally in the cortex of a Wistar rat. An ethanol bolus (1 g/kg) was delivered at the sixty-minute mark. Data were transformed to changes in ethanol concentration based on each sensor's post-calibration. INSET: The raw, untransformed current (nA) from the two alcohol biosensors as acquired through Pinnacle's acquisition software.

CONTINUOUS GLUCOSE MONITORING

Pinnacle's **CONTINUOUS GLUCOSE MONITORING SYSTEM, (CGMS)** is designed to obtain real-time interstitial glucose measurements in freely moving rats with one-second temporal resolution. Our turn-key system capitalizes on over 15 years of experience as innovators in rodent biosensor technology to deliver a simple 17 day+ subcutaneous sensor for use in diabetes and metabolic studies. The sensor is connected to a backpack wireless Bluetooth® transmitter. Combine this with our user-configurable CGMS software for remote monitoring and easy data analysis.



HARDWARE

- 1 A durable, tear-resistant, water-resistant pouch houses the electronics and battery.
- 2 A low power wireless potentiostat applies a bias and transmits up to two digitized signals to a Bluetooth® USB dongle that interfaces with Pinnacle's Sirenia® Acquisition software for data recording.
- 3 The glucose sensor penetrates the animal's subcutaneous space on the dorsal surface and is held in place with four surgical sutures.
- 4 The system uses a jacket to secure the pouch and stabilize the sensor.

HARDWARE KITS

8100-K5-BP: 2-Channel Potentiostat Kit for Rats

8164 - 2-channel LE Bluetooth wireless potentiostat backpack

9052 - 3' USB extension cable

9054 - Smart Bluetooth® dongle

9080 - Zinc air battery (Package of 4)

8100-K11-BP: 1-Channel Potentiostat Kit for Mice

Components of this kit are the same as above except 8164 is replaced with 8164-M and 9080 is replaced with 9065-8164-M.

ACCESSORY KIT

8100-K7-BP: CGMS Accessories

8134 - Test load

8156 - Battery remover (plastic)

8165 - Rat jacket

8166 - Electronics pouch

8167 - Suture packets: 3-0 silk

8168 - Tegaderm: 1624W (6cm x 7cm)

8169 - 18 g needle

9005 - Powered USB hub

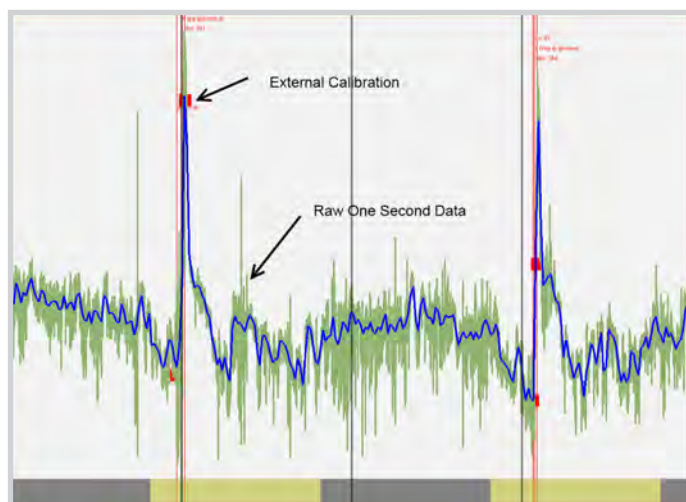
9080 - Zinc air battery (Package of 4)

8100-K12-BP: CGMS Accessories for Mice

Components of this kit are the same as above except 8165-S is replaced with 8176 and 9080 is replaced with 9065-8164-M.

HARDWARE SPECIFICATIONS

	RATS	MICE
System Weight	5.9 grams	3.8 grams
Battery Life	25 days +	17 days +
Channels	2	1
Transmission Radius	20 feet	20 feet

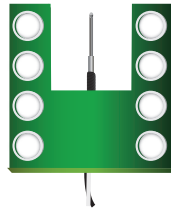


Within the Pinnacle CGMS environment, data are under the control of the researcher. Raw, once-per-second samples and filtering capabilities are available. The above graph represents 48 hours of data (grey bar = dark cycle).

SENSORS

Pinnacle's **CONTINUOUS MONITORING SUBCUTANEOUS SENSORS** are designed for easy implantation, allowing for a rapid and simple surgery. The sensors allow for raw second-by-second data collection for real time data analysis. For more details on the sensor, see page 4.

CGMS SENSOR SPECIFICATIONS



Sensor Range: 10-500 mg/dL

Sensor Life: 17+ days

Our CGMS glucose sensors do not react to the following interferents: galactose, creatinine, urate, xylose, warfarin, acetaminophen, naproxen, maltose, xanthine, and aspirin.

BIOSENSOR

7006-Glucose: Subcutaneous Biosensor-Glucose

SOFTWARE

Pinnacle's **SIRENIA® CGMS SOFTWARE** provides a turn-key solution for acquiring, monitoring, and analyzing preclinical glucose data. Our software's versatile tools enable users to quickly visualize trends, monitor data acquisition remotely, calculate comprehensive statistical reports, and create customized charts and graphs. Data, statistics, and graphs can be exported as high-resolution images for professional presentations. Pinnacle's software is specifically tailored for CGMS experiments, saving you time by simplifying your data analysis.

KEY FEATURES

Daily Modal Alerts

Programmable Alerts

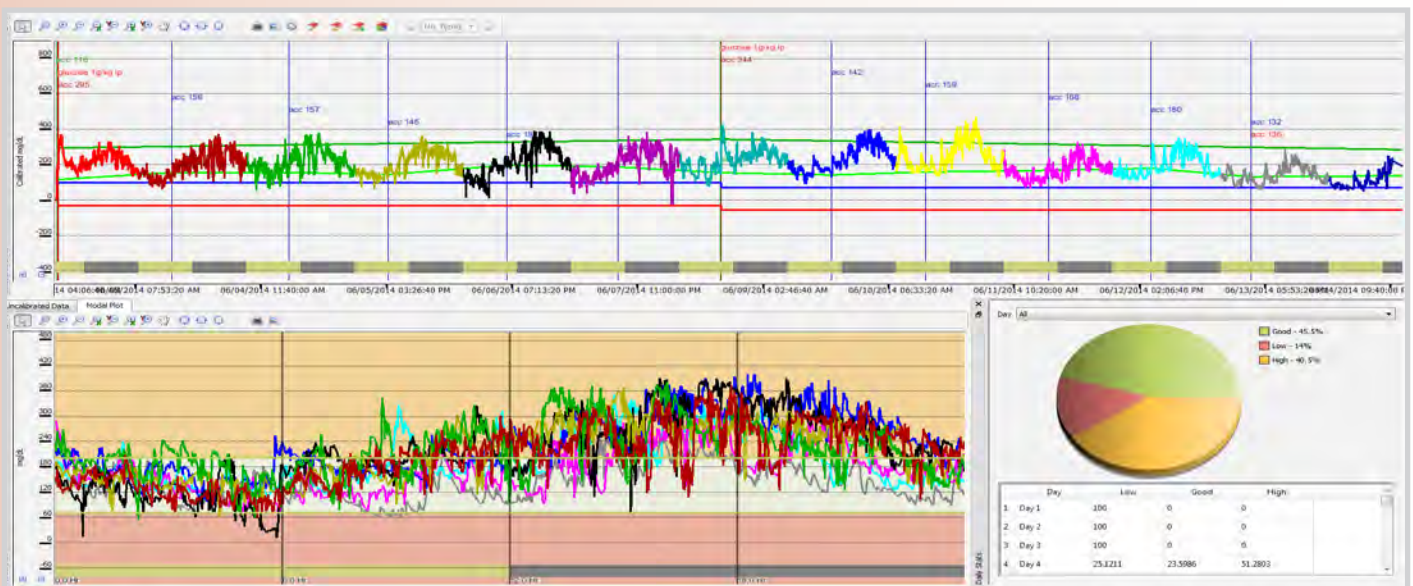
Easy Trend Visualization

Remote Monitoring

SOFTWARE

9041-K: Sirenia® CGMS Software Kit

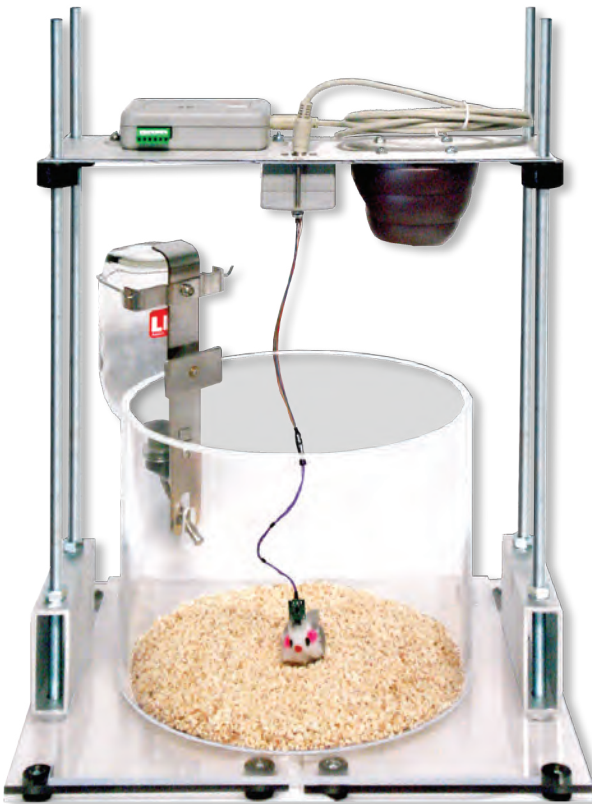
ADVANCED CGMS ANALYSIS SOFTWARE



Our CGMS software module includes extensive analysis features to visualize data and create customized plots, charts, and graphs. Generate graphs tailored to your data with user-defined variables and settings.

EEG/EMG SYSTEMS

THREE-CHANNEL AND FOUR-CHANNEL BIOPOTENTIAL TETHERED RECORDING SYSTEMS are available for sleep, seizure, and general behavioral paradigms in freely moving mice and rats. Both EEG/EMG systems use head-mounted preamplifiers to produce exceptionally clean waveforms, even during animal movement. The four-channel system provides all the great features of the three-channel system along with an extra channel, configuration flexibility, and the added capability of incorporating simultaneous CNS biosensor measurements. See the “System Features” chart to determine which system better fits your research needs. Pinnacle also offers a three-channel wireless system for rats.



TETHERED SYSTEMS

SYSTEM FEATURES	3 CHANNEL	4 CHANNEL
Available for both mice and rats	✓	✓
Optimized for sleep and seizure experiments	✓	✓
No cable artifact	✓	✓
Adjustable gain and low-pass filters	✓	✓
Sampling rate up to 20,000 Hz per channel		✓
Digital input/output controls	✓	✓
Analog output option	✓	✓
Fully configurable channels		✓
CNS Biosensor support		✓
Reconfigure via preamplifier exchange		✓

- **Tethered System Breakdown & How Preamplifiers Work:** Pages 12-13
- **Three- & Four-Channel Systems, Hardware & Accessory Kits:** Pages 14-15
- **Add a Biosensor to EEG/EMG Recordings:** Page 15
- **Wireless System for Rats:** Page 16

COMMON USES



SLEEP STUDIES



SEIZURE RESEARCH



DEPTH ELECTRODES



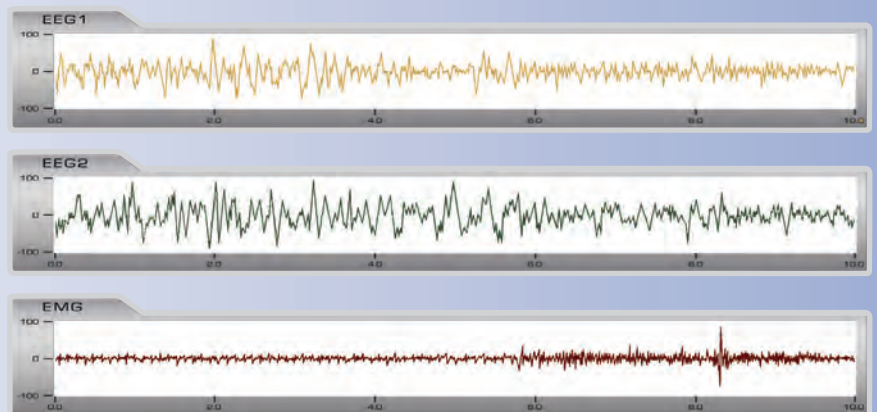
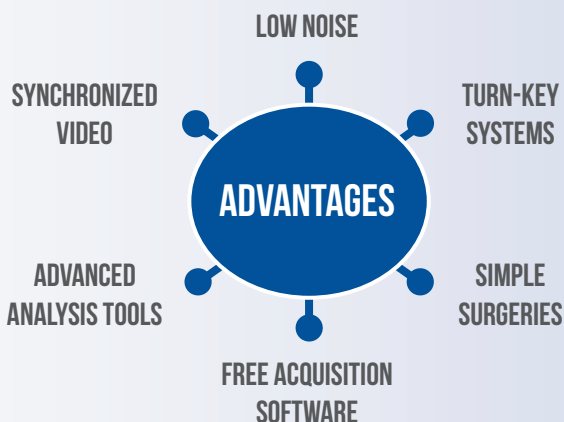
CORTICAL RECORDINGS



COGNITIVE STUDIES



LOCAL FIELD POTENTIAL



Two channels of EEG data can be captured alongside EMG data using Pinnacle's three-channel biopotential recording system.

TETHERED SYSTEM BREAKDOWN

OUR TURN-KEY SYSTEMS are engineered to deliver clean, artifact-free data. EEG and EMG waveforms are amplified and filtered at the head of the animal by a preamplifier. Signals are then passed through the low-torque swivel to the data conditioning and acquisition system for final-stage amplification and filtering. Each channel in our three- and four-channel systems features independent, adjustable gain and filter settings.

Data are collected using Pinnacle's free acquisition software, Sirenia®. The software allows users to view EEG/EMG recordings in user-defined time periods, manually score sleep, and review seizure events. All data can be configured for export to most spreadsheet and database programs and are compatible with our advanced analysis software packages. *See pages 23-24 for additional information on Pinnacle software.*

TETHERED SYSTEMS FOR RATS

COMMUTATOR



A Plastics One commutator is mounted above the cage. The commutator's two-plug setup allows for even rotation of the rotor.

□ 8214 ■ 8409

CABLE



An 18" tether from Plastics One connects the commutator to the preamplifier. The cable's wires are protected by a metal spring coil.

PREAMPLIFIER

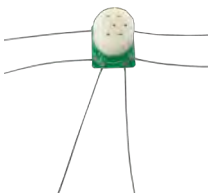


Signals are amplified and filtered at the head of the animal using our preamplifiers, which ensures the delivery of clean, artifact-free data. A Plastics One screw connector is used to secure the preamplifier to the head of the animal.

□ 8213 ■ 8407

RAT HEADMOUNT

Prefabricated rat headmounts use Plastics One fittings mounted on a 9 mm X 9 mm board with EEG or EMG electrode wires attached. An additional two-pin electrode is used for 4 EEG configurations.



DATA CONDITIONING AND ACQUISITION

A data conditioning and acquisition system (DCAS) performs secondary amplification and filtering before sending data to Pinnacle's Sirenia® Acquisition software for collection via a USB connection.

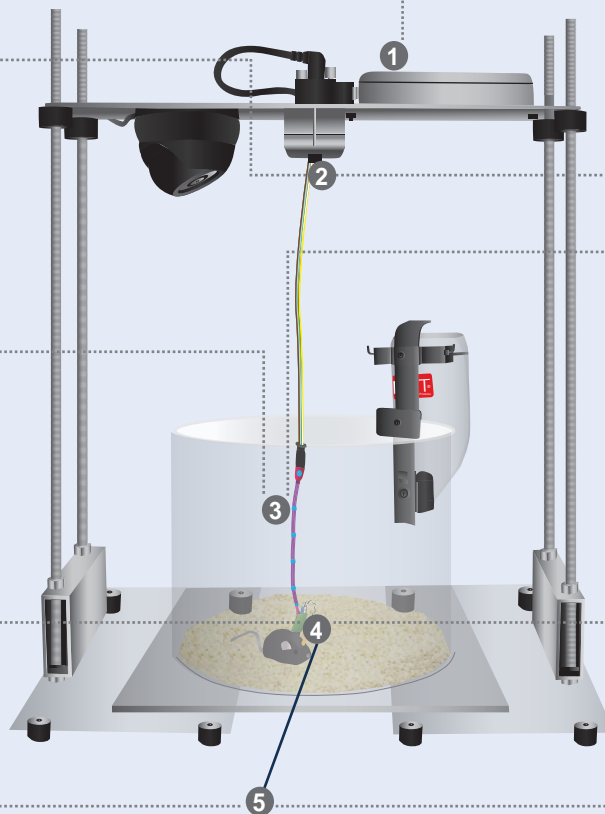
SPECIFICATIONS (8401-HS)

- Adjustable Sampling Rates: 200 - 20,000 Hz
- Software Configurable Low-Pass Filters: 10 Hz - 1 kHz
- Max Bit A/DC: 16
- 4 TTL Input/Outputs and 4 Analog Outputs

□ 8206 ■ 8401-HS

PRODUCT PART NUMBER KEY:

□ 3-Channel System ■ 4-Channel System





TETHERED SYSTEMS FOR MICE

COMMUTATOR

A low-torque commutator, which is mounted above the cage, allows for unencumbered freedom of movement.

Rotational Torque: $<2 \times 10^{-4}$ N-m

□ 8204 ■ 8408



CABLE

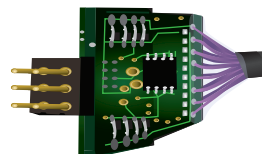
A 14" tether connects the commutator to the preamplifier. Six insulated wires are banded together to create this lightweight cable that is ideal for use with very small animals.



PREAMPLIFIER

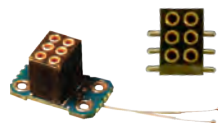
Signals are amplified and filtered at the head of the animal using our preamplifiers. This ensures the delivery of clean, artifact-free data. The mouse preamplifier connects to a headmount via a friction fit.

□ 8202 ■ 8406



MOUSE HEADMOUNT

Prefabricated headmounts reduce surgery time, allow for reproducible electrode placement, and provide ready-to-insert EMG leads.



Six-pin or eight-pin connectors support flexible electrode placement for customizable cortical or depth recordings.

HOW OUR PREAMPLIFIERS WORK

GAIN AND HIGH-PASS FILTERS

Pinnacle's high-gain preamplifiers perform X100 amplification (X10 in seizure rat configurations) of differential measurements between two electrodes. Each channel also features 0.5, 1.0, or 10 Hz high-pass filters. Use the chart below to identify the exact preamplifier specifications for each channel type in your selected configuration.

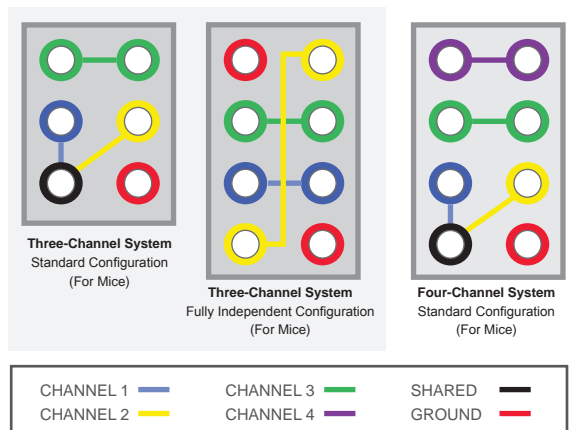
For example, a 2 EEG/1 EMG preamplifier configured for seizure studies in mice has a gain of X100 on all channels, 1.0 Hz high-pass filters on the EEG channels, and 10 Hz high-pass filters on the EMG channel.

MOUSE CONFIGURATIONS		GAIN	HIGH-PASS FILTERS
EEG Channel(s)	Seizure	X100	1.0 Hz
	Sleep	X100	0.5 Hz
EMG Channel	Seizure	X100	10 Hz
	Sleep	X100	10 Hz
RAT CONFIGURATIONS		GAIN	HIGH-PASS FILTERS
EEG Channel(s)	Seizure	X10	1.0 Hz
	Sleep	X100	0.5 Hz
EMG Channel	Seizure	X10	10 Hz
	Sleep	X100	10 Hz

SHARED AND FULLY INDEPENDENT CHANNELS

Standard three- and four-channel preamplifiers have two channels sharing a common electrode and either one or two independent channels, respectively. Fully independent, differential preamplifiers are also available. See diagrams below.

Perspective: Pins extending from preamplifier



CUSTOM CONFIGURATIONS AVAILABLE

Contact a Pinnacle representative
at (785) 832-8866

THREE-CHANNEL SYSTEMS

Pinnacle's **THREE-CHANNEL TETHERED SYSTEM** allows researchers to simultaneously record three channels of EEG and/or EMG data. The data conditioning and acquisition system (DCAS) and preamplifier are preconfigured and ordered as a matching pair. Standard configurations include 2 EEG/1 EMG channels for sleep or seizure studies and 3 EEG channels for seizure research. Fully independent preamplifiers and 3 EEG kindling systems for rats are also available. *Learn more about preamplifiers and how our turn-key systems work on pages 12-13.*

SYSTEMS FOR MICE

HARDWARE KITS

Configuration	Sleep	Seizure
2 EEG/1 EMG	8200-K1-SL	8200-K1-SE
2 EEG/1 EMG*	8200-K1-iSL	8200-K1-iSE
3 EEG		8200-K1-SE3
3 EEG*		8200-K1-iSE3

Contents:

- 8202 - Mouse preamplifier
- 8204 - Mouse commutator/swivel
- 8206 - Data conditioning and acquisition system
- 8258 - 14" mounting plate

Cables for one animal, software, and manuals are also included.
NOTE: Products 8202 and 8206 come in multiple varieties: SL, SE, SE3, DSL*, DSE*, and DSE3*.

* Fully Independent

ACCESSORY KITS

8200-K3-SL/SE: 2 EEG/1 EMG for Sleep or Seizure

8201 - Mouse headmount (4)	8249 - Test source
8209 - 0.10" screws (pkg. of 8)	8254 - 23-gauge needle (4)
8212 - 0.12" screws (pkg. of 8)	8255 - Multimeter
8226 - Twin pack of silver epoxy (2)	9005 - Powered USB hub
8241-F - Screwdriver for EEG screws	

8200-K3-iSL/iSE: 2 EEG/1 EMG for Sleep or Seizure*

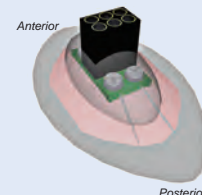
Components of this kit are the same as above except 8201 is replaced with 8431-SM. In addition, it contains an 8-pin to 6-pin adapter (8272) and 20-0.10" screws with wire leads (8403) instead of products 8209, 8212, and 8226.

8200-K3-SE3: 3 EEG for Seizure

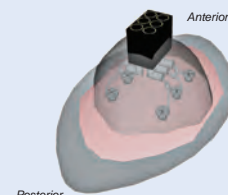
Components of this kit are the same as above except 8201 is replaced with 8235-SM. In addition, it contains 24-0.10" screws with wire leads (8403) instead of products 8209, 8212, and 8226.

8200-K3-iSE3: 3 EEG for Seizure*

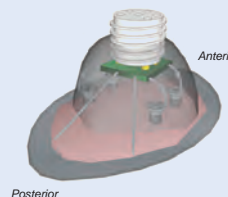
Components of this kit are the same as above except 8201 is replaced with 8415-SM. In addition, it contains an 8-pin to 6-pin adapter (8272) and 28-0.10" screws with wire leads (8403) instead of products 8209, 8212, and 8226.



2 EEG / 1 EMG for Mice



3 EEG for Mice



2 EEG / 1 EMG for Rats

SYSTEMS FOR RATS

HARDWARE KITS

Configuration	Sleep	Seizure
2 EEG/1 EMG	8200-K2-SL	8200-K2-SE
3 EEG		8200-K2-SE3

Contents:

- 8206 - Data conditioning and acquisition system
- 8213 - Rat preamplifier
- 8214 - Rat commutator/swivel
- 8258 - 14" mounting plate

Cables for one animal, software, and manuals are also included.
NOTE: Products 8206 and 8213 come in three varieties: SL, SE, and SE3.

ACCESSORY KITS

8200-K4-SL/SE: 2 EEG/1 EMG for Sleep or Seizure

8112 - Drill bit	8249 - Test source
8239 - Rat headmount (4)	8255 - Multimeter
8241-S - Screwdriver for 1/8" screws	9005 - Powered USB hub
8247 - 1/8" screws with wire leads (16)	

8200-K4-SE3: 3 EEG for Seizure

Components of this kit are the same as above except for the quantity of 8247 (24). In addition, 8239 is replaced with 8239-SE3.

All accessory kits contain items needed for completion of four or six surgeries. All quantities are (1) unless otherwise noted after the product description.

HAVE YOUR OWN AMPLIFIER?

Learn more about using Pinnacle's preamplifiers with third-party systems on page 27.

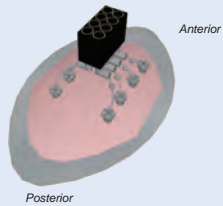
DISPOSABLE ITEMS

FOR RATS

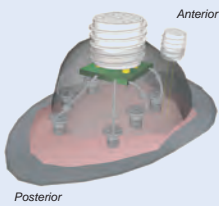
Item #	Product
8112	Drill bit
8239	2 EEG/1 EMG rat headmount
8239-SE3	3 EEG rat headmount
8247	1/8" screws with wire leads
8425	2-pin electrode

FOUR-CHANNEL SYSTEMS WITH BIOSENSOR OPTION

The **FOUR-CHANNEL TETHERED SYSTEM** supports up to four biopotential input channels. This system is among the most flexible of Pinnacle's hardware devices because users can easily modify the configuration by changing only the preamplifier. Standard configurations include 3 EEG/1 EMG channels and 4 EEG channels for seizure research. *For system and preamplifier specifications, refer to pages 12-13.* Users can also add a biosensor channel. Any Pinnacle CNS biosensor can be used in conjunction with our four-channel EEG/EMG system for recording up to two simultaneous biosensor channels. Adding biosensors enables the correlation of biopotential and neurochemical activity in freely moving mice and rats, making the system perfect for unlocking new findings during sleep, seizure, and behavioral studies. It is also possible for the system to acquire two biosensor inputs on a single channel. This allows for the simultaneous capture of data from three biopotential and two biosensor signals. *Learn more about biosensors on pages 4-5.*



4 EEG for Mice



4 EEG for Rats

SIMPLE SURGERIES

Pinnacle's prefabricated headmounts and connectors provide fast and easy solutions for connecting electrodes to preamplifiers. Stainless steel screws affix to the skull, doubling as anchors and electrodes for EEG data acquisition. Depth electrodes can be soldered to connectors for LFP recordings. For configurations supporting muscle movement, EMG leads easily insert into the back or neck muscles.

CNS biosensors sold separately.

SYSTEMS FOR MICE

HARDWARE KIT

8400-K1: Mouse EEG/EMG System
8401-HS - Data conditioning and acquisition system
8408 - Mouse commutator/swivel
8426 - 18" mounting plate
Cables for one animal, software, and manuals are also included.

PREAMPLIFIER KITS

8400-K3-SE31M: 3 EEG/1 EMG for Seizure
8400-K3-SE4: 4 EEG for Seizure
8400-K3-SE: 2 EEG/1 EMG/1 Biosensor for Seizure
8400-K3-SL: 2 EEG/1 EMG/1 Biosensor for Sleep
8400-K3-SSE: 2 EEG/1 EMG/2 Biosensor for Seizure
8400-K3-SSL: 2 EEG/1 EMG/2 Biosensor for Sleep
8400-K3-SE3: 3 EEG/1 Biosensor
8400-K3-SSE3: 3 EEG/2 Biosensor

All preamplifier kits include one preamplifier, one-time purchase items and surgical disposables to complete four surgeries.

SYSTEMS FOR RATS

HARDWARE KIT

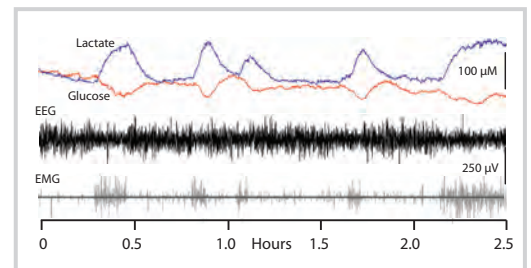
8400-K2: Rat EEG/EMG System
8401-HS - Data conditioning and acquisition system
8409 - Rat commutator/swivel
8426 - 18" mounting plate
Cables for one animal, software, and manuals are also included.

PREAMPLIFIER KITS

8400-K4-SE4: 4 EEG for Seizure
8400-K4-SE-BAS: 2 EEG/1 EMG/1 Biosensor for Seizure
8400-K4-SL-BAS: 2 EEG/1 EMG/1 Biosensor for Sleep
8400-K4-SE3-BAS: 3 EEG/1 Biosensor

All preamplifier kits include one preamplifier, one-time purchase items and surgical disposables to complete four surgeries.

COMBINED EEG/EMG/BIOSENSOR SYSTEMS



EEG and EMG waveforms are plotted simultaneously with calibrated biosensor traces for lactate and glucose recorded from a single animal.

FOR MICE

Item #	Product
8201	Mouse headmount
8201-SS	Mouse headmount (stainless steel)
8209	0.10" screws (pkg. of 8)
8212	0.12" screws (pkg. of 8)
8226	Twin pack of silver epoxy

Item #	Product
8235-SM	6-pin connector
8254	23-gauge needle
8403	0.10" screws with wire leads
8415-SM	8-pin connector
8431-SM	3 EEG/1 EMG headmount

ADD SYNCHRONIZED VIDEO

See page 22 for details.

WIRELESS EEG/EMG SYSTEM FOR RATS

The lightweight, head-mounted Bluetooth® wireless Model 8266 for rats measures 3 biopotentials simultaneously and presents the data in real-time for review. The battery life is greater than 36 hours, using off-the-shelf batteries. For longer studies, the removable battery pack can be quickly and easily changed. The data are streamed to a computer using a small USB dongle receiver and the standard Sirenia® software suite. In addition, our proven rat EEG/EMG electrode placement system ensures fast setup, and consistent, reliable results.

HARDWARE KIT

8200-K6-SL: 2 EEG/1 EMG Wireless Sleep System for Rats

8266-SL - 3-Channel Wireless EEG/EMG Amplifier/Transmitter for Rats

8266-SL-Bat - Battery for 8266-SL

9054 - Bluetooth® Dongle

9052 - USB Cable

8294 - 8266 Manual

9028 - Sirenia® CD

9029 - Sirenia® Manual

9080 - Zinc Air Battery (Package of 4)

ACCESSORY KIT

8200-K8-SL: 3-Channel Wireless EEG/EMG Amplifier/Transmitter Accessories

9005 - Powered USB Hub

8266-SL-Bat - Battery for 8266-SL

8107-WSL - Rat Hat top for 8266-SL

8108-WSL - Rat Hat bottom for 8266-SL

8241-S - Screwdriver for Rat Bone/EEG Screws

8112 - Drill Bit for 1/8" Bone/EEG Screws

8247 - 1/8" EEG Screw with Wire Lead for Rats (16)

8270 - 2 EEG/1 EMG headmount for 8266 potentiostat

9080 - Zinc Air Battery (Package of 4)

8156 - Battery Remover (plastic)

8255 - Multimeter

8249 - EEG/EMG Test Source

8271-RA - 6-pin Connector - Male Double Sided Adaptor

8235 - 6-pin Connector for Mice - Straight Pin Configuration



Pinnacle's wireless EEG/EMG System



SYSTEM MEASUREMENTS

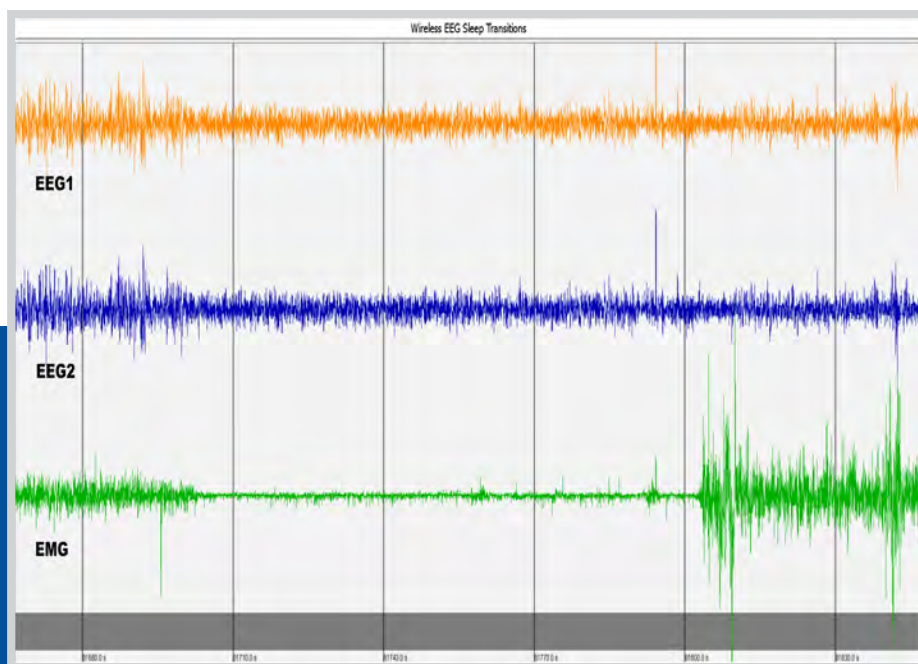
3 Biopotential Channels	12-bit Resolution
Samples/sec (on each channel)	200
Battery Life*	36+ hours
System Weight**	23 g

*For longer studies the removable battery pack can be easily replaced without disassembling the head-mounted enclosure.

** Includes batteries, enclosure, and electronics.

**SEE OUR SIRENIA®
SLEEP PRO SOFTWARE**

Details on page 24.



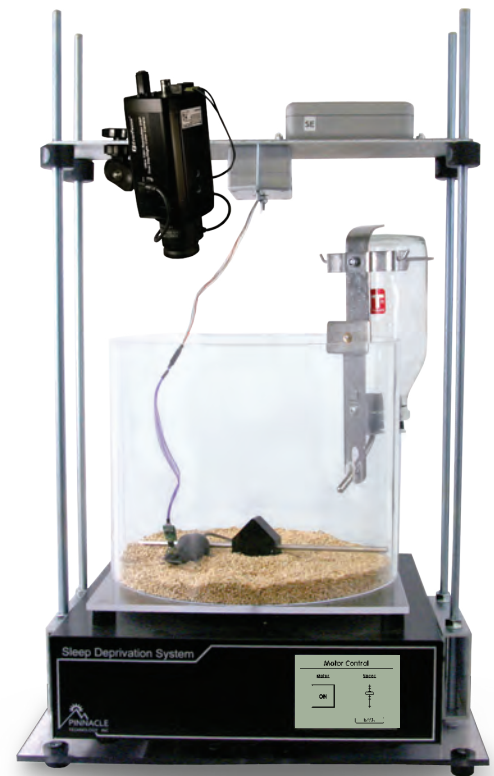
An example data set from the wireless EEG/EMG system showing sleep transitions.

SLEEP DEPRIVATION SYSTEM

Pinnacle's **AUTOMATED SLEEP DEPRIVATION SYSTEM** is a unique solution for sleep deprivation and fragmentation studies. It provides user controls for sleep depriving mice and rats without direct human intervention. Sleep deprivation simulating gentle handling is achieved by a rotating bar placed a short distance above the cage floor, lightly nudging the animal from sleep and encouraging the animal to maintain wakefulness without excessive exercise. The system is sold either as **STAND ALONE** or with **FEEDBACK**. The feedback version includes all the features of the stand-alone system. In addition, EEG/EMG signals can be used to determine sleep/wake state and initiate deprivation as required. It includes a license key for unlocking Sirenia's versatile sleep deprivation settings.

TWO SLEEP DEPRIVATION SYSTEMS

SYSTEM FEATURES	STAND ALONE	FEEDBACK
Available for both mice and rats	✓	✓
Adjustable speed and motor control	✓	✓
Calendar-based scheduling	✓	✓
Suitable for short-term, long-term, and chronic studies	✓	✓
Optional video recording	✓	✓
Real-time biopotential analysis and feedback		✓
Rule-based programming		✓
Yoked control functionality		✓
Requires Pinnacle's EEG/EMG system		✓
Compatible with third-party systems	✓	



FEEDBACK SYSTEM WITH SYNCHRONIZED VIDEO

ADVANTAGES

Simulates gentle handling

Reduces unnecessary exercise

Minimizes resources compared to manual deprivation

Prevents sleep acclimation and habituation

COMMON USES



SIMULATED SHIFT WORK



AUTOMATED DEPRIVATION



SLEEP FRAGMENTATION

AUTOMATED SLEEP DEPRIVATION SYSTEMS

Product	Item #
Stand Alone for Mice	9000-K5-S
Feedback for Mice	9000-K5
Stand Alone for Rats	9000-K6-S
Feedback for Rats	9000-K6

STAND ALONE SYSTEM

The **STAND ALONE SYSTEM** provides calendar-based functionality for programming the bar to rotate at discrete intervals. Programming options range from a second-by-second basis to hourly, daily, weekly, or monthly intervals. Use the device's touchscreen to operate the system without a computer connection. The system is compatible with most EEG/EMG hardware and physiological measurement systems.

FEEDBACK SYSTEM

The **FEEDBACK SYSTEM** provides calendar-scheduling functionality plus the capability of adding real-time EEG/EMG feedback to ensure the bar rotates only when the animal enters a sleep-like state. Bar rotation starts and stops automatically based on user-established rule sets for the animal's sleep state, and users can easily incorporate delays, shifts in bar rotation, and time restrictions into the experimental setup.

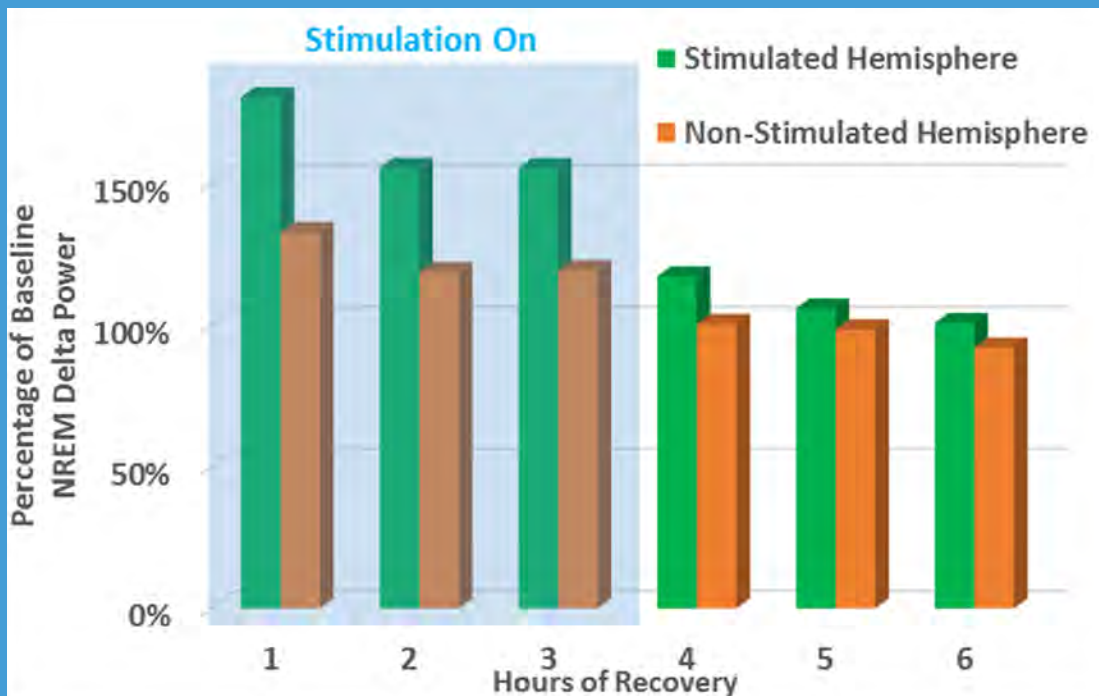
OPTOGENETICS

In 2010, *Nature Methods* declared **OPTOGENETICS** the “Method of the Year.” The same year, *Science* called it the “Breakthrough of the Decade.” To help our customers, Pinnacle is developing a user friendly, turn-key hardware and software system integrating electrophysiological and neurotransmitter measurements, along with video for behavioral studies, with precise optogenetic control. The system is designed to optically trigger genetically altered neurons in one or more specific brain regions with simultaneous recording of electrophysiological signals or neurotransmitter concentration changes.

The key component is an Optogenetics Interface Module which provides precise timing and illumination control when integrated with our existing 3- and 4-channel data acquisition systems. This connects to an electrical commutator and a headstage (overall design is similar to diagram on page 12). The system uses LED fiber probes which are compatible with standard cannula placement techniques and do not require an optical commutator. Four headstages are currently available: 1- or 2-channel stimulation only for behavior studies, 1-channel stimulation plus EEG/EMG for sleep studies, or 1 channel stimulation plus EEG for seizure research.

OPTOGENETIC INTERFACE MODULE

- Includes a stable, highly accurate, clock to ensure < 10 μ s timing accuracy for all events controlled directly by module
- Interfaces with all Pinnacle Data and Acquisition Systems (8200 & 8400)
- Precise current and pulse timing control for the fiber optic probes (current control and pulse timing can also be provided by an external source)
- 3 digital inputs, 1 digital output
- 2 isolated inputs for other external stimuli



A representative data set using Pinnacle's 1 Opto/2 EEG/1 EMG sleep headstage and 470 nm wavelength LED fiber probe. The contralateral hemisphere EEG headmount was used (page 19). A transgenic mouse was continuously sleep deprived for 6 hours. During the first 3 hours of the recovery period, optogenetic stimulation was delivered (10 Hz, 80 ms pulse width). EEG and EMG recordings were then analyzed for comparison of delta power (0.5 to 4 Hz) in NREM epochs between the optogenetically stimulated hemisphere to the non-stimulated hemisphere.

LED FIBER PROBES

Pinnacle's optogenetic stimulation is based on LEDs coupled to 62.5/125 μm fiber optic cable with a minimum light output of 10 mW/ mm^2 . The LED fiber probes are implanted using a guide cannula and standard stereotaxic techniques. The LED fiber probe assembly plugs directly into a 2 mm electrical header on the headstage, removing any requirements for an optical commutator.

HARDWARE AND ACCESSORIES

The core hardware kit for mice includes all necessary items excluding the headstage. The headstages are sold by kits which include all the supplies necessary for 4 surgeries and one-time purchase items. If you already own a Pinnacle Data Acquisition System, it is compatible with the Optogenetics system.

HARDWARE KIT

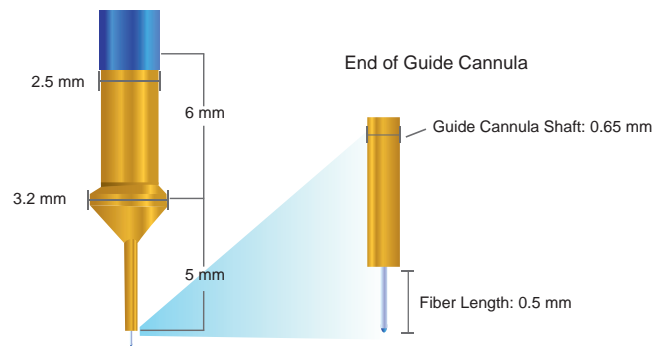
8400-K11: Optogenetics Core Mouse System
8401-HS - 4-Channel Data Conditioning & Acquisition System
8480 - Optogenetic Interface Module
8481-M - Optogenetic Commutator for Mice
8413-M - 6" 15-pin Cable
8426 - Mounting Plate 18"
8260 - Power Supply
9026 - Power Supply Splitter Cable
9002 - USB Cable
9008 - USB Driver Install Disc & Installation Instructions
8495 - 8400 User Manual
8496 - Optogenetics User Manual
9028 - Sirenia® CD
9029 - Sirenia® Manual

HEADSTAGE KITS

8400-K13-O1: 1 Opto Headstage Kit
8400-K13-O2: 2 Opto Headstage Kit
8400-K13-O1/2EEG/1EMG: 1 Opto/2 EEG/1 EMG Sleep Headstage Kit
8400-K13-O1/3EEG: 1 Opto/3 EEG Seizure Headstage Kit

Most National Instruments devices are mapped as virtual devices which can then be accessed within Sirenia®. This capability allows researchers to use existing equipment to supplement a wide range of high temporal accuracy optogenetics experiments.

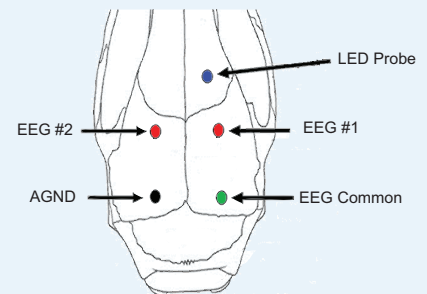
LED FIBER PROBES FOR MICE



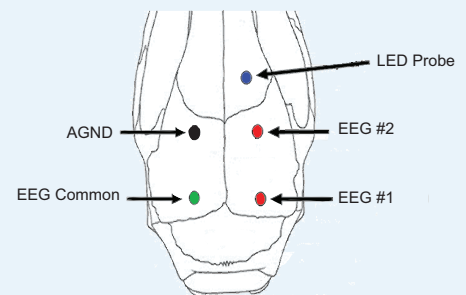
Product	Item #
LED Fiber Probe 470 nm Wavelength	7080-470-3

EXPERIMENTAL DESIGN

An optogenetics experiment is driven by the placement of the optical stimulation in the brain. Based on the researcher's requirements, the choice of a headmount is critical. Two examples are shown below for a sleep experiment. The LED Fiber Probe can be placed in either hemisphere of the brain.



For different hemisphere recordings, use the 8402-SS-90 headmount

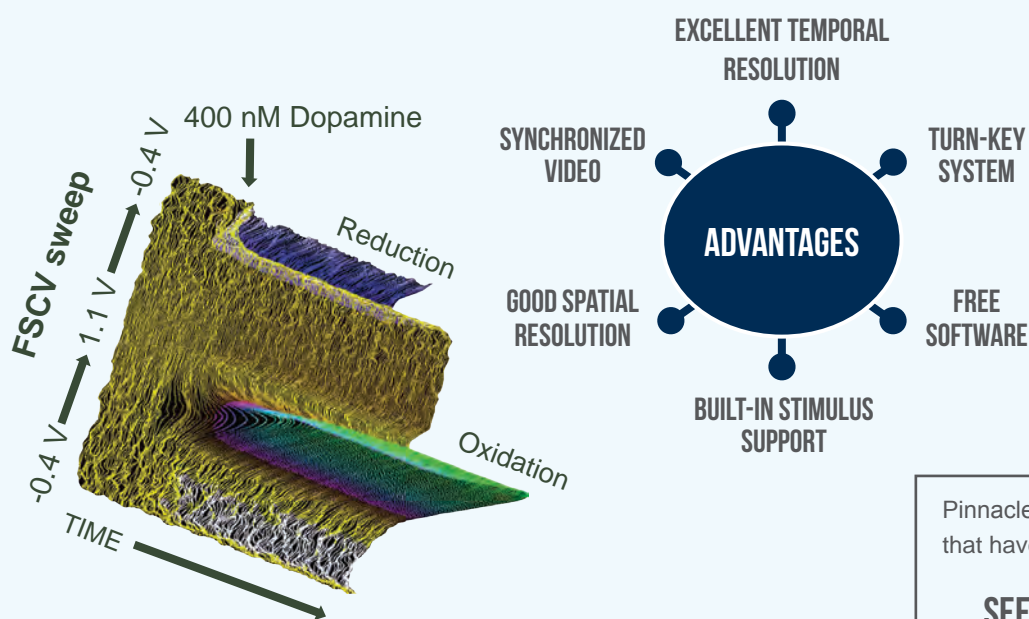
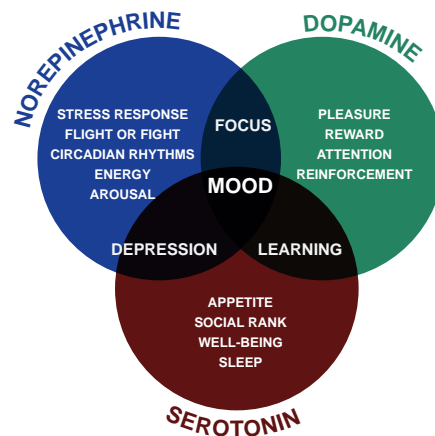


For same hemisphere recordings, use the 8402-SS headmount

CUSTOM PROBES AVAILABLE

FAST SCAN CYCLIC VOLTAMMETRY SYSTEM

Pinnacle's **FAST SCAN CYCLIC VOLTAMMETRY (FSCV) SYSTEM** is robust, turn-key, and specifically designed to simplify the measurement of catecholamines (i.e., dopamine, norepinephrine, and serotonin). It functions by rapidly cycling a voltage across an implanted carbon fiber sensor and measuring the resultant current. Both the tethered system for mice and the wireless system for rats have built-in support for controlling an external stimulus. The system is shipped with Pinnacle's 8500 software.



SWEEP SPECS

Voltage span:	-1.1 V to +1.3 V
Range:	250 - 400 V/s
Sweeps/second:	5 - 10
Points/sweep:	1000

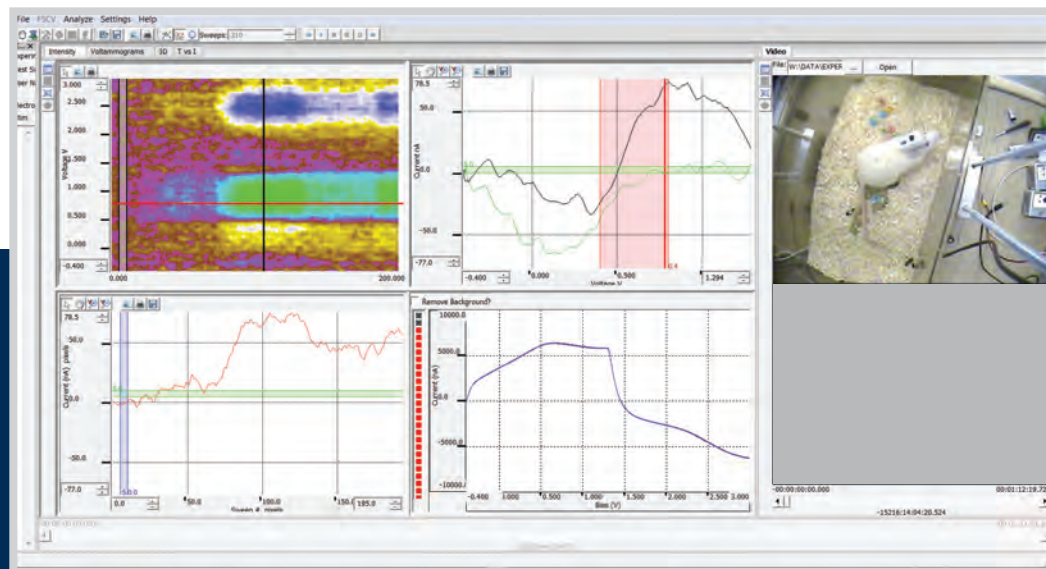
Pinnacle offers a complete line of carbon fiber sensors that have been optimized for FSCV applications.

SEE PAGES 4-5 FOR MORE INFORMATION

SOFTWARE FEATURES

The 8500 software supports traditional, short recording paradigms (recordings of two minutes or less) as well as longer-term recordings using an extended, continuous mode.

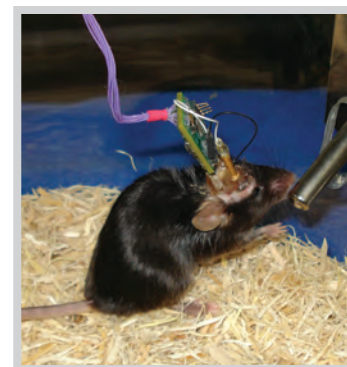
- Background subtraction
- Heat maps
- 3D visualization
- User-selectable filters
- Animated voltammograms
- Data export



A screenshot of Pinnacle's 8500 software with integrated video.

TETHERED SYSTEM FOR MICE

The **TETHERED FSCV SYSTEM** allows researchers to harness the powerful genetics of the mouse model to address underlying mechanisms of biogenic neurotransmitter release and function. A head-mounted FSCV board sends signals through a low-torque commutator to an interface box that streams data to the host PC.



Pinnacle's tethered FSCV system.

HARDWARE KITS

8500-K1: FSCV Mouse System (tethered)

8408 - Mouse commutator

8426 - 18" mounting plate

8503 - Tethered FSCV headstage

8504 - FSCV interface box

Cables for one animal, software, and manuals are also included.

ACCESSORY KITS

8500-K3: FSCV Accessories for Mice (tethered)

7033 - Bio-only headmount (4)

7036 - Clamp rod

7037 - Probe clamp accessory

7039 - Allen wrench

8212 - 0.12" screws (pkg. of 8)

8241-F - Screwdriver for mouse screws

8254 - 23-gauge needle (4)

8509 - 100K test load

8510 - 100M test load

9005 - Powered USB hub

9033 - NiMH batteries (pkg. of 4)

9034 - Battery charger

KEY FEATURES

SWEEP RATE: 10 SWEEPS/SECOND

1000 POINTS/SWEEP

HEAD-MOUNTED AMPLIFICATION

LOW-TORQUE SWIVEL

CALIBRATION KIT

Product

Item #

FSCV Calibration Kit*

8500-K5

* Used for mouse and rat systems

WIRELESS SYSTEM FOR RATS

The **WIRELESS RAT SYSTEM** uses Bluetooth® to transmit data. The system resides in a head-mounted enclosure and wirelessly transmits data to a computer. The battery is easily accessible and readily exchangeable in real-time to support extended recordings. The system is ideal for mazes and enclosed environments, such as metabolic and behavioral chambers.

HARDWARE KITS

8500-K2: FSCV Rat System (wireless)

8501 - Wireless FSCV board

8502 - Bluetooth® dongle

9052 - USB extension cable

Software and manuals are also included.

ACCESSORY KITS

8500-K4: FSCV Accessories for Rats (wireless)

7036 - Clamp rod

7038 - Probe clamp accessory

7039 - Allen wrench

8111 - 1/8" screws (pkg. of 12)

8112 - Drill bit

8147-A - Hex screwdriver

8241-S - Screwdriver for 1/8" screws

8506 - Battery with cover

8507 - Rat Hat top

8508 - Rat Hat bottom (4)

8509 - 100K test load

8510 - 100M test load

9024 - Battery charger



Pinnacle's wireless FSCV system.

KEY FEATURES

SWEEP RATE: 5 SWEEPS/SECOND

1000 POINTS/SWEEP

BLUETOOTH® TRANSMISSION

RECORD FROM MULTIPLE ANIMALS WITHIN THE SAME ROOM

Carbon fiber sensors and Ag/AgCl reference electrodes are sold separately.



FOR MICE

Item #	Product
7033	Bio-only headmount
8212	0.12" screws (pkg. of 8)
8254	23-gauge needle
9033	NiMH batteries (pkg. of 4)

FOR RATS

Item #	Product
8111	1/8" screws (pkg. of 12)
8112	Drill bit
8506	Battery with cover
8508	Rat Hat bottom

SYNCHRONIZED VIDEO CAPABILITY

Pinnacle's **VIDEO SYSTEM** can record up to four simultaneous *in vivo* experiments on one computer. Our Sirenia® software synchronizes video recordings with biopotential and biosensor data, providing an accurate representation of an animal's overt behavior in conjunction with its physiological response. The video system consists of two components—a base computer package and a camera package. Together they provide everything you need to incorporate video capture into your research. The video system is compatible with all of Pinnacle's hardware systems. Order it as an accessory to a new system, or easily integrate it into your current Pinnacle setup. It can also be used as a stand-alone video system. Camera options are described below.

KEY FEATURES

- Record in color or grayscale
- Record in low light or complete darkness
- Flexible file size management
- Synchronized video with data recordings
- Unrestricted video playback
- Record from any angle (Box/HD)

OPTION 1

Pinnacle's dome camera mounts above the cage. Its built-in infrared illumination adjusts to lighting conditions automatically, allowing video recording in reduced lighting and complete darkness.

OPTION 2

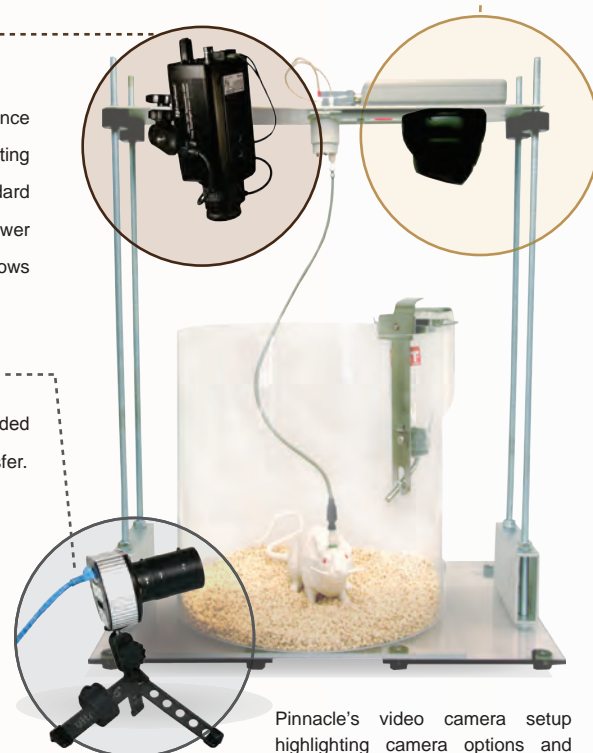
The box camera has improved optics and low-light performance compared to the dome camera, as well as flexibility in mounting options. It can be mounted above the cage using Pinnacle's standard mounting plate, on the cage stand, or to a tripod for recording at lower angles. A separate, automatic infrared illumination source allows video capture in conditions of low light and complete darkness.

OPTION 3

The high definition (HD) Internet protocol (IP) camera includes all the features of the box camera with the added capability of recording at six times the resolution. The camera uses a single cable for power and data transfer.

FEATURES	DOMES	BOX	HIGH DEFINITION
Lens	3.6 mm (internal)	4 mm (external)*	2.8 - 12 mm variable (external)*
Max Resolution	640 x 480 pixels	640 x 480 pixels	1920 x 1072 pixels
Max Frame Rate	30 fps	30 fps	30 fps
Mount	Above	Above, Side, Tripod	Above, Side, Tripod
IR Source	Integrated	Independent	Independent
Color/Grayscale	Both	Both	Both
Interface	Analog	Analog	Digital Ethernet

* Accepts standard C-mount lens



Pinnacle's video camera setup highlighting camera options and mounting configurations. The independent IR source is not shown.

SYNCHRONIZED VIDEO SYSTEM

Product	Item #
Base Video Computer Package	9000-K1

Includes a preconfigured computer, a high-definition monitor, a docking station for easy data transfer, a keyboard and mouse, and cables. Up to four cameras can be added to a single video system. Cameras are sold separately.

CAMERA PACKAGES

Product	Item #
Dome camera with integrated IR source	9000-K9
Box camera with independent IR source	9000-K10
HD camera with independent IR source	9000-K11
Additional HD cameras with independent IR source	9000-K12

Each camera package includes a camera, IR source, mounting accessories, extension cable, and one Sirenia® license key.

ADDITIONAL PRODUCTS

Product	Item #
Variable Focus Lens (Box)	9056-VF
Tripod (Box and HD)	9059
Illuminator	9057
Enhanced Illuminator	9057-EN

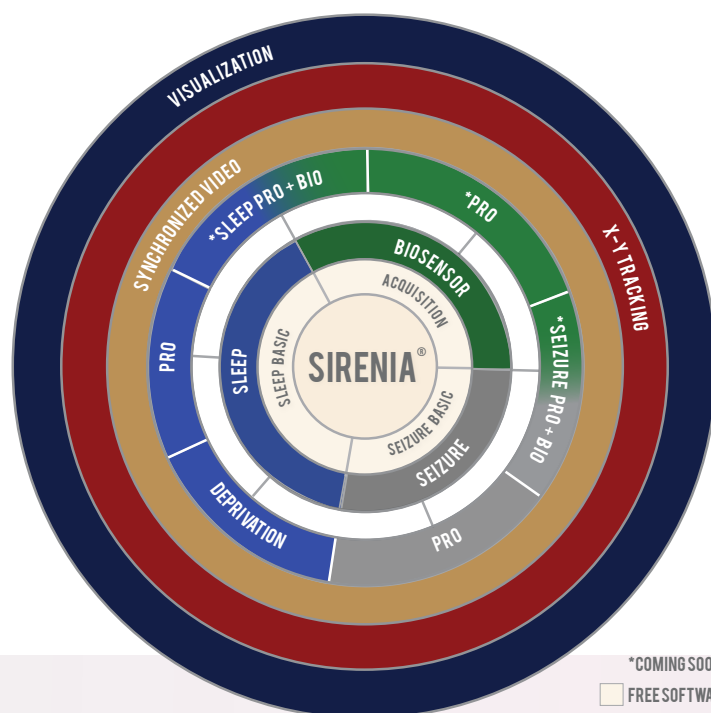
Integrated video can be added to any Pinnacle recording system through the Sirenia® software platform. Video is synchronized within 100 milliseconds to simultaneous EEG, EMG, or biosensor data.

SIRENIA®

Pinnacle's **SIRENIA® SOFTWARE** provides powerful tools for preclinical research. Our **FREE** Sirenia® platform includes acquisition and basic analysis software, and users can easily add **PREMIUM MODULES** at any time.



- Supports synchronized video
- I/O functionality
- Data consolidation
- Flexible data management
- Record from multiple Pinnacle devices using one platform
- Multiple export capabilities



*COMING SOON
FREE SOFTWARE

FREE ACQUISITION

Sirenia® Acquisition provides a single platform for recording data from any Pinnacle hardware system, excluding FSCV. The software features synchronization of all data streams, user-configurable settings, data consolidation, and multiple export options. In addition, the download includes basic review and analysis modules for biosensor, sleep, and seizure recordings. Sirenia® delivers all-in-one software that is ideal for data acquisition and review.

VISIT OUR WEBSITE TO DOWNLOAD SIRENIA® TODAY!

www.pinnaclet.com/sirenia-download.html

THIRD-PARTY DATA STREAMS

Sirenia® supports the integration of third-party data streams via a National Instruments I/O module. These data can be simultaneously recorded along with Pinnacle's biopotential and biosensor data.

Product	Item #
National Instruments I/O module	9032

PREMIUM MODULES

PAID SOFTWARE MODULES

Product	Item #
Sirenia® Seizure Pro Analysis Software	9037
Sirenia® Sleep Pro Analysis Software	9035
Sirenia® Visualization Software	9074
Sirenia® X-Y Tracking Software	9039
Sirenia® CGMS Software	9041

The software packages can be installed on multiple computers, though each seat is limited to one computer running the program at a time. Purchase includes one year of free upgrades. Contact Pinnacle at sales@pinnaclet.com for additional package options.



SEIZURE PRO

Quickly identify and analyze events in your data using the line length and power characteristics of user-defined seizures.



SLEEP PRO

Score mouse and rat data in 75% less time using automated tools, such as cluster and threshold scoring.



VISUALIZATION

Manipulate and view data with our innovative graphical analysis software.



X-Y TRACKING

Precisely track animal movement in real time and quickly analyze behavioral patterns based on trajectories, quadrant analysis, and much more!



CGMS

Monitor and analyze your preclinical glucose data with our software specifically tailored for CGMS experiments.

Download the free software trials at
www.pinnaclet.com/software.html

30-DAY
FREE
TRIAL

LEARN MORE ABOUT THESE TIME-SAVING MODULES: PAGES 24-25

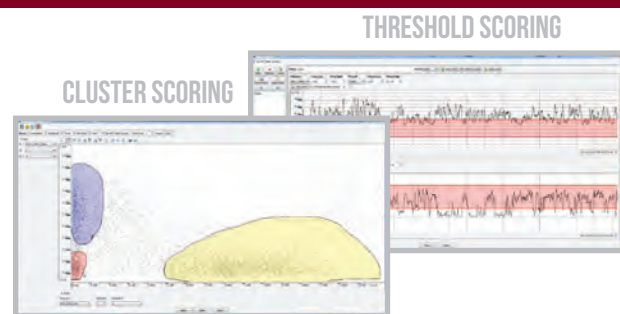
PREMIUM SOFTWARE MODULES FOR SLEEP AND SEIZURE

Upgrade from our basic software to automate your sleep scoring and seizure identification processes. Both **SIRENIA® SLEEP PRO** and **SIRENIA® SEIZURE PRO** provide automated tools for rapid data analysis. All EEG/EMG and video data sets recorded with Pinnacle software, as well as third-party EDF files, can be imported for analysis.

SIRENIA® SLEEP PRO

Sleep Pro provides three mechanisms for scoring sleep data: manual, cluster, and threshold scoring. Combine multiple methods to quickly and accurately score both mouse and rat files. Epoch lengths are user-configurable, and numerous scoring sessions can be created for the same file. In addition, real-time hypnograms, epoch-by-epoch heat maps, and spectral plots are available as visual aids. Plus, powerful analysis tools, such as sleep stage/sleep bout analysis and user score comparison, make reviewing and exporting data easy.

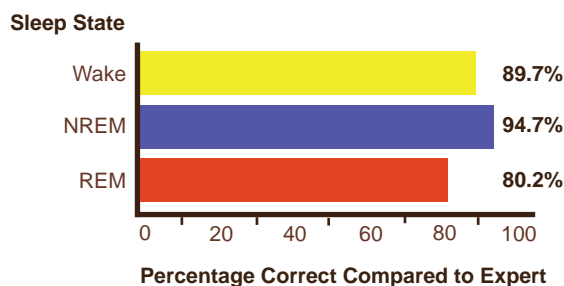
KEY FEATURES



- Multiple scoring tools
- Real-time hypnograms
- Spectral plots
- Heat maps
- Power analysis
- Peak frequency analysis

ACCURACY OF SLEEP DETECTION

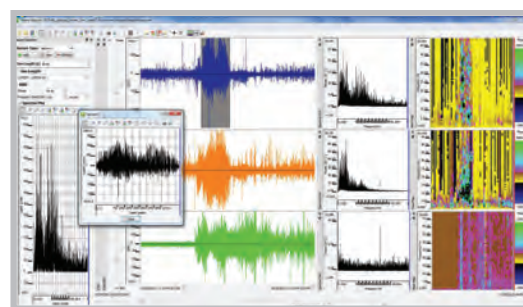
A combination of cluster, threshold, and manual scoring tools were used by four experienced and novice scorers to separately score three different **mouse data** files. All files were compared to expert hand-scored data files. The overall average agreement of the four scorers for all the files as compared to the expert is shown below.



SIRENIA® SEIZURE PRO

Seizure Pro employs a database system to store line length and power characteristics of user-defined seizures. Information collected in the database is used to quickly identify and mark like-events within any Sirenia® or EDF file. Racine's scale ratings, seizure classification, and notes can be easily added to logged events for future reporting. Plus, spectral plots and heat maps are available to aid in visual confirmation. Seizure statistics, including average duration, time between seizures, and peak frequency, are automatically generated.

KEY FEATURES



- Automated seizure identification
- Spectral density heat maps
- Spectral plots
- Power analysis
- Time analysis
- Seizure statistics

ACCURACY OF SEIZURE DETECTION

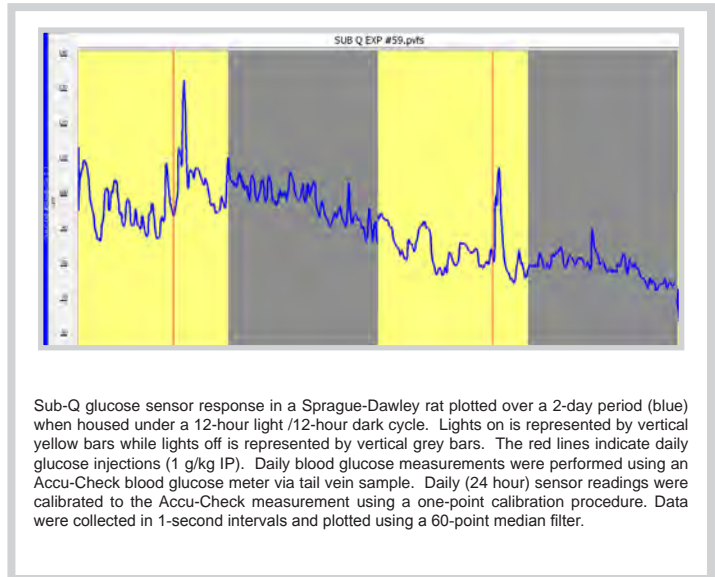
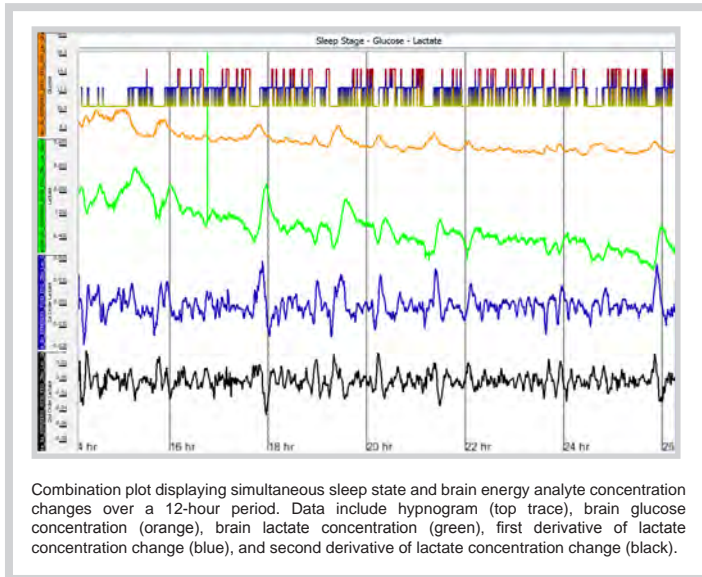
Seizure detection was performed using RMS power and line length separately on five individual **mouse data** files. All files were compared to an expert hand-scorer's files. Agreement of the two detection methods as compared to the expert is shown below.

	# of Seizure Events Marked	Accuracy vs. Expert Scorer	# of False Positives
Expert Scorer	21	N/A	N/A
RMS Power	23	100%	2
Line Length	21	100%	0

Data courtesy of Drs. Philip Haydon and Jerome Clasadonte (Expert Scorer)
Tufts University School of Medicine, Department of Neuroscience

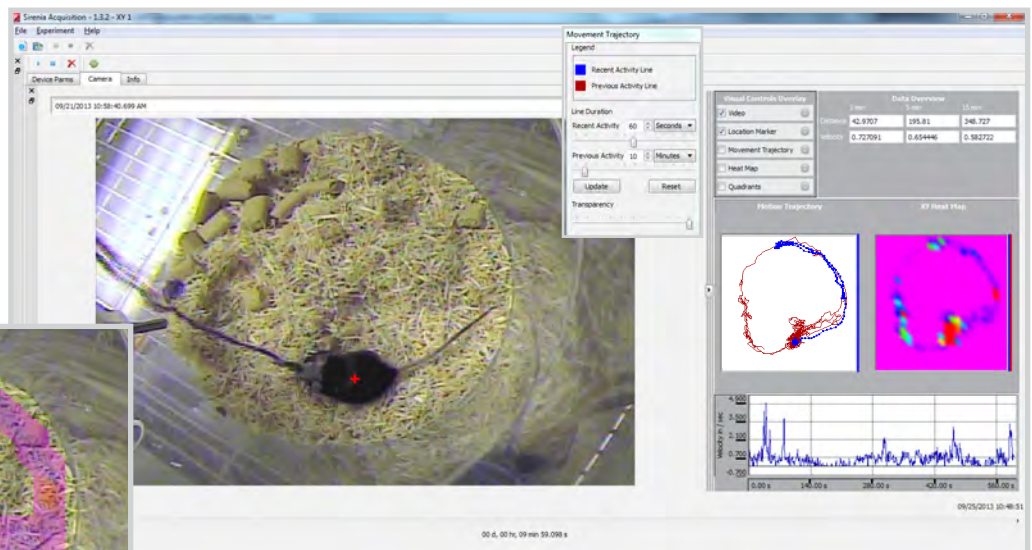
SIRENIA® VISUALIZATION

SIRENIA® VISUALIZATION allows for fast and easy manipulation and transformation of time-series data. Data can be easily transformed using a single constant applied to the entire data set or a series of values for specific ranges of data. Additional features include customizable data filtering, data overlay capabilities, and time-period highlighting. Users can easily zoom in and out to view detailed changes in the data. Plus, all charts and graphs can be saved as high-resolution images for use in publications and presentations. Pinnacle's visualization software is included with all Sirenica® Sleep Pro and Seizure Pro purchases or can be purchased separately.





SIRENIA® X-Y TRACKING





SIRENIA® X-Y TRACKING enables users to accurately detect and analyze animal movement within a cage. Users can track locomotor behavior in real-time or in previously recorded video data. In addition, our software can be calibrated to different cage types and is compatible with tethered and wireless animals, making Sirenica® X-Y tracking applicable to a variety of experimental paradigms. Analyzed data can be saved as high-resolution images or exported as TSV, EDF, and TXT files.



Above: Tethered mouse data were recorded using Pinnacle's box camera and IR illuminator. Movement was then analyzed with Sirenica® X-Y Tracking. The animal's motion trajectory, an X-Y heat map, and distance and velocity data are displayed on the right side of the screen. **Left:** An X-Y heat map is displayed over the video image. Settings are fully customizable.

-  Real-time tracking
-  X-Y heat maps

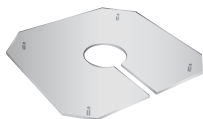
KEY FEATURES

-  Motion trajectory analysis
-  Distance and velocity traveled
-  User-defined regions
-  Quadrant analysis

ANIMAL HOUSING

CIRCULAR CAGES AND CAGE ACCESSORIES are designed to allow rodents to freely move around a cage. All cages are made of ¼" clear acrylic and are suitable for use with most commercial cage washing equipment. Multiple sizes are available. Cages and accessories also support tethered experiments.

CAGE LID



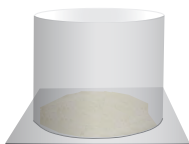
Cage lids allow for additional containment of active animals. Lids provide security and can be easily removed for cleaning and feeding.

CAGE EXTENDER



Increase the height of our standard cages using cage extenders. The extenders fit snugly on top of Pinnacle's cages and add 4" (per extension) to cage height.

CAGE



Pinnacle's cages are ideal for rodent research. The circular design allows the animal complete freedom of movement around the circumference of the cage. The open top makes cleaning and feeding easy and accessible. One water bottle, which attaches to the outside of the cage, is included with each purchase. For tethered setups, our circular cage design prevents excessive slack and tension in the cable.

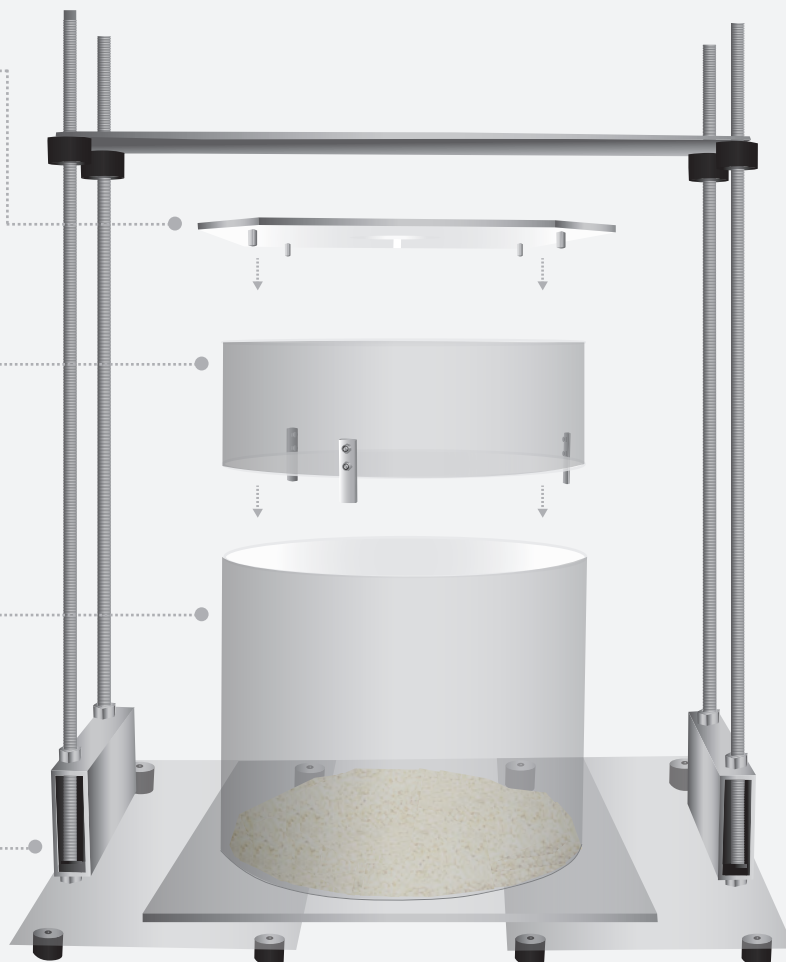
CAGE STAND



Pinnacle's stands accommodate a single animal cage and mounting plate. The split design is compatible with both mouse and rat cages and all of Pinnacle's tethered recording systems. There are two stand options. They are adjustable to 24" (61 cm) and 36" (91.4 cm) tall.

CAGE PRODUCTS

Product	Item #
Cage for mice - 10" diameter, 8" tall (25.4 x 20.3 cm)	8228
Cage for rats - 12" diameter, 12" tall (30.5 x 30.5 cm)	8238
Cage for rats - 14" diameter, 12" tall (35.5 x 30.5 cm)	8273
Cage lid for mice (for use with #8228)	8265-M
Cage lid for rats (for use with #8238)	8265-R
Cage lid for rats (for use with #8273)	8265-R14
Cage extender for mice (for use with #8228)	8228-4ex
Cage extender for rats (for use with #8238)	8238-4ex
Cage extender for rats (for use with #8273)	8273-4ex
Cage stand - adjustable to 24" tall (61 cm)	9009
Cage stand - adjustable to 36" tall (91.4 cm)	9009-RSD

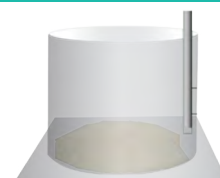


NEED EXTRAS?

Product	Item #
Water bottle with holder	8251
14" mounting plate (35.5 cm)	8258
18" mounting plate (45.7 cm)	8426

FOOD HOPPER

An integrated food hopper can be added to any Pinnacle cage. The stainless steel food hopper attaches to the inside of the cage, holds approximately 50 grams of food (~12 standard pellets), and dispenses one pellet at a time. It reduces disturbance to the animal and requires little maintenance during long-term experiments. Add a second food hopper to increase the amount of food available.



Product	Item #
Food Hopper	9066

MISCELLANEOUS ITEMS

MASTER CLOCK



KEY FEATURES

- High-precision synchronization
- 3 TTL inputs/outputs and pulse train output support
- Accurate to 1 second per month

Product	Kit #
Master Clock	9000-K8*

The **MASTER CLOCK** is a central timing source for experiments that require high-precision synchronization of multiple devices. Our system provides an accurate (< 1 ppm from 0 to 70 °C) clock and three TTL I/O ports. It communicates with Sirenia® data acquisition software using a USB

cable. The combination of a master clock and the Sirenia® software suite allows users to perform a range of experiments requiring precise synchronization while using multiple video and data interfaces. Because it optimizes synchronization, the master clock is perfect for optogenetics, behavioral studies, and other protocols requiring ultra-precise timing.

ILLUMINATORS

The eighth edition of the *Guide for the Care and Use of Laboratory Animals* specifies narrow illumination limits. The Pinnacle 9057-EN illuminator offers infra-red (IR) and visible lighting that can be automatically synchronized to your standard lighting schedule or controlled via USB. This illuminator can be programmed to provide true dawn/dusk transitions and scheduled lighting variations. By adding a photosensor, the unit can automatically turn on or off with room lighting (photoresistor cable) or by adding a lux meter (lux cable), the unit will provide quantifiable measurements of illumination levels at the base of the cage and consistent lighting over multiple experimental setups. The base version (9057) provides IR lighting for video.



Product	Item #
Illuminator	9057
Enhanced Illuminator	9057-EN
Lux Cable	9057-LUX
Photoresistor Cable	9057-PHO

ISOLATED WIRELESS POTENTIOSTAT



This general purpose, wireless, two-channel potentiostat can be used for a wide range of amperometric systems, including lab-on-chip and biosensors. Its isolated design makes it uniquely suited for in-channel and end-channel detection in capillary electrophoresis systems. The system is powered by a standard 9V battery and uses Smart Bluetooth® telemetry to a USB dongle for reliable data transfer. The potentiostat is fully supported by Pinnacle's Sirenia® software suite.

Product	Kit #
Isolated Wireless Potentiostat	9000-K7*

KEY FEATURES

- Portable
- Sample rate: 13 Hz
- Bias range: 0 - 4 V
- Resolution: 24 bits
- Bluetooth® transmission
- Transmission range: 6 m
- Current range: 80 uA
- Battery life: ~100 hrs (continuous use)

ANALOG ADAPTER



Analog adapters are excellent solutions for researchers who have existing amplification/acquisition systems but require the noise reduction provided by Pinnacle's head-mounted preamplifiers and commutators. The adapters can be used to connect Pinnacle mouse and rat preamplifiers with third-party data collection systems.

Product	Kit #
3-Channel Analog Adapter	8242-K*
4-Channel Analog Adapter	8442-K*

COMMUTATOR



Pinnacle's mouse commutators are ideal for use in studies that require a low-torque electrical swivel. The lightweight nature of our commutators provides a platform to transfer electrical signals without significantly altering the behavior of the animal. Custom adapters can be ordered for integration into existing third-party cabling/connection schemes. Available for mice only.

Product	Item #
Six-pin commutator	8204
Nine-pin commutator	8408
Ten-pin commutator	8481-M



LEARN MORE

Pinnacle's products are used daily to advance research at academic institutions, research hospitals, government laboratories, contract research organizations, and pharmaceutical companies across the world. Learn more about how current customers are using our products by visiting the Info Center on our website at www.pinnaclet.com/info-center.html.



PUBLICATIONS

Many Pinnacle customers regularly publish their scientific work in peer-reviewed journals. This space is dedicated to sharing our customers' research with other users of Pinnacle products and systems.



POSTERS

Missed a conference? Visit us online to review recent posters presented by Pinnacle and our customers at Neuroscience, AES, Sleep, and other major conferences.



LINKEDIN FORUM

Sign up for our LinkedIn group to network and share information with other scientists, researchers, technicians, and executives who are shaping the biomedical research field.



CONFERENCES

Pinnacle Technology regularly attends scientific conferences and meetings hosted both in the United States and internationally. Please stop by our booth at upcoming conferences to chat with a representative about how our cutting-edge tools can improve and simplify your research. Visit our website at www.pinnaclet.com/conferences.html for a complete list of events.



DISTRIBUTORS

Pinnacle Technology is proud to make our products available to an international customer base by teaming with a growing list of distributors from across the globe. Visit our website at www.pinnaclet.com/distributors.html for an updated list.

